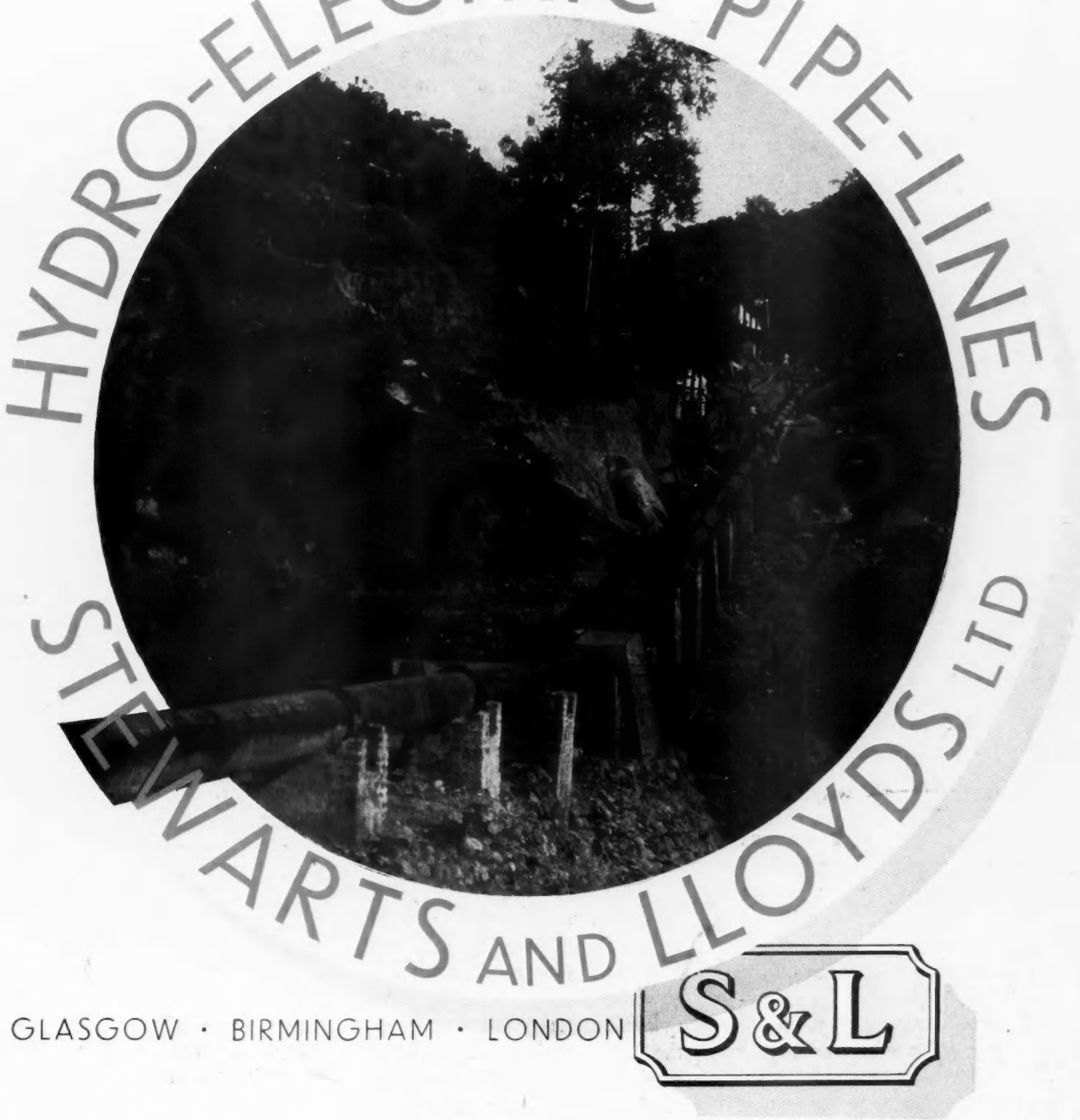
Engineering
Library

JUN

The Engineer

ESTABLISHED 1856. REGISTERED AS A NEWSPAPER.

VOL. CLIX.—No. 4144] 28, ESSEX ST., LONDON, W.C. 2. [JUNE 14, 1935



THREE ESSENTIAL GROUPS OF CORROSION RESISTING STEELS

STAINLESS "STAYBRITE"

The stainless group of steels embraces the various qualities of 14 per cent chromium steel originally developed solely for cutting purposes. Resistant to a wide range of the ordinary corroding influences which cause rust, they are therefore now widely applied throughout the engineering trades for details which have to operate under normal corrosive conditions. Besides cutlery and surgical instruments, large tonnages are supplied for such varying application as turbine blading, steam valves, golf club heads, ball and roller bearings, aircraft fittings and details in hydraulic plant. The steels in this group can be hardened and tempered by simple heat treatment to cover tensile requirements from as low as 30 tons up to 100 tons per square inch.

S.80

Lying between the stainless and the "Staybrite" groups is this steel containing 18 per cent chromium and 8 per cent nickel. It is intermediate as regards structure, and although it is superior to the former in corrosion resistance, it does not quite come up to those optimum characteristics which distinguish the "Staybrite" steels. It may be hardened by heat treatment to a maximum tensile strength to the order of 60/75 tons, and is therefore of the greatest value for high tensile spindles and shafts, as well as for bolts and studs working under corrosive conditions.

This more recent group of steels containing 18 per cent chromium and 8 per cent nickel was primarily developed for optimum resistance to the most severe conditions of corrosive attack. They are essentially rust and acid resisting steels and by critical adjustments of analysis can be adapted to meet the majority of the most severe corrosion problems. These steels are characterised by medium tensile strengths of the order of 40/50 tons per square inch coupled with high impact strength and unusual ductility. They therefore lend themselves to production by all the accepted fabricational methods, and so diverse are their applications that they range from shopfronts to the largest chemical plants, and from kitchen sinks to coinage.

FIRTH — VICKERS STAINLESS STEELS LTD.
STAYBRITE WORKS SHEFFIELD

A Seven-Day Journal

Technical Education.

ON Monday last at Bournemouth, in his presidential address at the annual Conference of the Association of Teachers in Technical Institutions, Mr. D. W. Lloyd, referring to the hours of work, study, and leisure of part-time evening students, said that to qualify for the ordinary National Certificate in Engineering (to take one example only) as a part-time student demanded (*a*) a minimum attendance in three subjects three evenings a week; (*b*) the submission of a maximum amount of homework and probably written-up practical work as well. Both (*a*) and (*b*) must be achieved concurrently. Therefore, for a session of about twenty-eight weeks the student gets up before 7 a.m., carries out a forty-eight-hour week at work, attends for a minimum of six hours at classes, and needs to do at least three hours' homework. While praising the assiduity of the student, Mr. Lloyd marvelled that so many young people were so consistent both in attendance and in achievement, but queried the value of such a feature in our educational system. He hoped that the time would come when, for the sake of efficiency, a liberal concession of "time off" for part-time day attendance would be made without a financial penalty. It was to be deplored that the students' final attainment might be jeopardised by irregular attendance owing to the demands of overtime. Mr. Lloyd earnestly suggested that, in addition to the many committees of inquiry set up by the Government, another be formed with a basis of reference—"Inquiry into the hours of work, study, and leisure of the adolescent." "Is there not," he asked, "something wrong with an industrial system that demands many hours of overtime from workers during 'rush' periods while acquiescing in 'short time' or discharge when times are 'slack'?"

A London Transport Scheme.

ON Wednesday, June 5th, speaking in the House of Commons, Mr. Neville Chamberlain, the Chancellor of the Exchequer, announced a £35,000,000 plan for the improvement of London transport. He said that as a result of negotiations which had lasted over many months, arrangements had been concluded between the Government and the Standing Joint Committee of the London Passenger Transport Board and of the main line railways. Under these, subject to the necessary parliamentary sanctions, the Transport Board, the London and North-Eastern Railway, and the Great Western Railway, will enter at once upon a programme of great improvements and extensions of London transport. In addition to the extensive schemes of work included in the private Bill of the Transport Board now before Parliament, the new programme covers the electrification of the suburban lines of the London and North-Eastern Railway in North-East London into Liverpool-street, and also of some lines in North London, and the construction or extension of tube railways to give new connections between these electrified lines and the City and the West End. The proposed programme of construction will involve the building of about 12 miles of new tube railways, the electrification of about 44 miles of suburban railway, the doubling and electrification of about 12½ miles of further suburban railways, and the substitution of trollybuses for tramcars on 148 route miles. The loans necessary to be raised will be guaranteed by the Exchequer, and it is hoped to complete the works within a period of five years from the date of the loan.

The Military College of Science.

ON Thursday, June 6th, by kind invitation of the Commandant, staff and students, we attended an "At Home" at the Military College of Science, Woolwich. The College as our readers are doubtlessly aware, is primiarily devoted to the scientific instruction of officers of the Royal Artillery, Royal Engineers and Royal Corps of Signals and fulfils for the Army much the same function as Greenwich College fulfils for the Navy. The College also trains artificers for the Royal Artillery who are enlisted at about the age of fourteen years and spend five years in the College workshops and technical school. For the instruction and entertainment of the numerous visitors who attended last week's function a large number of exhibits and demonstrations were staged in the Chemistry, Metallurgy, Electrical and Mechanical Engineering and Physics Departments as well as in the branches devoted to the study of fire-control instruments, guns, small arms, and ammunition. The equipment of the College is very complete and the exhibits and demonstrations illustrated the wide and thorough training which the scientific officers of the modern Army are required to undergo. In the Chemistry Department we watched demonstrations of metal spraying, glass blowing, the dyeing of fabrics, and the properties of liquid air. The Metallurgical Department demonstrated die casting, surface combustion, and the use of thermit. Of the exhibits in the Electrical and Mechanical Engineering Sections the demonstrations of television, and apparatus for assisting in the instruction of motor drivers attracted chief interest. The Physics Department was not in wholly serious mood and included among its exhibits a demonstration of perpetual motion and other illusions and a short sketch entitled "The Unexpected Discovery" detailing the surprising adventures of a pavement artist in a physicist's laboratory was presented.

London Television Station.

AFTER carefully considering a number of possible sites, the Television Advisory Committee has recommended the adoption of the Alexandra Palace site for the projected London Television Station. This recommendation has been approved by the Postmaster-General and the British Broadcasting Corporation has made arrangements with the Alexandra Palace trustees for the use of a portion of the Palace buildings as a station. By means of a 300ft. mast an aerial height of 606ft. above sea level will be attained, which should enable a high-definition television service to be given to the London area. Both the Baird Television Company and the Marconi-E M I Television Company are to be invited to tender for the supply of apparatus for their respective systems. The Baird Company proposes the adoption of a standard picture definition of 240 lines sequential scanning, 25 picture traversals a second, 25 complete frames a second. The Marconi-E M I Company propose a standard of 405 lines, 25 pictures a second, interlaced to give 50 frames a second, each of 202½ lines. An alternative system may be introduced only with permission of the Advisory Committee, due public notice being given. It is proposed to radiate vision signals on about 6·6 m. wavelength and the associated sound signals on 7·2 m. If the tenders are accepted full information to facilitate the construction of receiving sets will be made available to manufacturers by the respective companies.

The "Mining Journal" Centenary.

WE would congratulate our esteemed contemporary the *Mining Journal* on its special number commemorating 100 years of mining history. The appearance of the *Mining Journal* on Saturday, August 29th, 1835, marked an important event in the beginning of an industrial era, for the construction of railways was just beginning, and the steam engine had already become a real force in industry, reducing costs and permitting a larger consumption of mineral products. The review of 100 years of progress which is undertaken in the centenary number shows in an unmistakable way the great advance the mineral industry has made from decade to decade, culminating in the boom year of 1929. Besides the historical evolution described in the review, the special centenary number contains a large number of articles written by leading specialists, which, with their statistical matter, clearly show the present position of the various branches of the mining industry. The review also notes the extraordinary advances made during the century in the development of mining plant, explosives, and methods of power generation, while the progress achieved in economic geology and prospecting is also recorded. Attention is given to the winning of gold and precious metals, and the rarer commercial metals, which are finding their place in a new range of alloys. The coal industry and the production of solid, liquid, and gaseous coal derivatives is touched upon, as is the modern oil industry.

A New Empire Liner.

THE announcement is now officially made that, arising out of the declarations made in September last by the Prime Ministers of Australia and New Zealand regarding the competition of foreign subsidised vessels in the trade between New Zealand and Australia, the directors of the Union Steam Ship Company of New Zealand have contracted for a fast and luxurious passenger vessel for the trade between the two Dominions. The new vessel is now on the stocks at the yard of Vickers-Armstrongs at Barrow-in-Furness, and her dimensions will be: Gross tonnage, 14,000; displacement, 15,000 tons; length overall, 544ft.; beam, 74ft. She will carry 400 first-class passengers, 160 tourist class passengers, and a limited number of steerage passengers, and will be propelled by Parsons single-reduction geared turbines taking steam from oil-fired water-tube boilers. She is intended to steam at 23 knots, which will enable her to make the passage between Sydney and New Zealand in 2½ days. The liner, which is not yet named, is expected to be launched in February and to be ready for sea in August of next year.

The Suez Canal Report.

THE directors' report of the Suez Canal Company for the year 1934, which was submitted at the recent annual general meeting, announced that although production and interchange have remained practically stationary, traffic through the canal for the whole of the year 1934 exceeded that of 1933 by approximately 3½ per cent. It was hoped that a continued improvement in traffic noted in the first months of the financial year would enable the company still further to lighten the burdens on the shipping industry. Unfortunately, the figure reached during the nine months in which the reduction of 1934 had been in force was below that of the corresponding period on 1933. That meant that the revival in traffic did not suffice entirely to compensate for the effects of the reduction in toll. Transits of the canal in 1934 amounted to 5663, representing a net register tonnage of 31,751,000, an increase of 3·5 per cent. on 1933. The weight of merchandise carried through the canal was 28,448,000 tons, 5·7 per cent. above the figure for 1933, but still 17·6 per cent. below 1929. The largest tonnage was furnished by mineral oils—5,136,000 tons, a rise of 203,000 tons. For the first four months of 1935 the net register tonnage transited was 10,730,000 tons, a similar figure to the 10,850,000 tons transited for the same period last year. Owing to the loss of M. Louis Barthou, a vacancy had occurred on the board of the company. General Weygand was nominated to fill it. A second post vacant through the death of M. Gabriel Cordier has been given to Sir Max Bahon, former general manager of the company.

The Fuel Research Station.

TUESDAY, June 4th, was visiting day at the Fuel Research Station, Greenwich, and a large company of scientists and industrialists took the opportunity of making themselves acquainted with the work which is being done by the Department of Scientific and Industrial Research in this particular field. The guests were received by Sir Harold Hartley, the Chairman of the Fuel Research Board, and by Dr. F. S. Sinnat, Director of Fuel Research. In the retort section of the Station, low-temperature carbonisation retorts, in a plant designed to deal with 6 to 10 tons of coal per day which have been in continuous use day and night since June, 1932, were inspected. As far as could be seen, they were still as good as when new. An important development in the hydrogenation of tar has taken place during the past twelve months, and a plant which is now producing motor spirit from tar on a semi-commercial scale was shown. The plant produces 9 gallons of motor spirit per hour. It is designed to work at a pressure of about 400 atmospheres and a temperature of 400 deg. Cent., and has been developed from laboratory experiments which were seen at last year's visitation. The amount of tar converted into spirit by the first hydrogenation has been increased from about 20 per cent. to the present 55 per cent.

A New L.M.S. Steamer.

THE new cross-Channel turbine steamer, "Duke of York," which has been built by Harland and Wolff, Ltd., at Belfast, for the Heysham-Belfast service of the London, Midland and Scottish Railway Company, underwent successful trials on the Skelmorlie measured mile last week, and has now been handed over to her owners. She is a ship of 3700 gross tons, with a length of 349ft. overall, a breadth moulded of 52ft., and a depth to main deck of 19ft. 6in. The propelling machinery comprises a twin-screw arrangement of Parsons single-reduction geared turbines, which take saturated steam at 225 lb. pressure from four boilers of the latest Babcock and Wilcox water-tube type. Each boiler is equipped with an electrically driven mechanical stoker of the multiple-retort, self-cleaning type. The boiler-room equipment includes hydraulic ash ejectors and an electrically driven clinker crusher., while spark arresters are incorporated in both funnels. There are two 150 kW auxiliary turbo-generator sets, and a 15 kW emergency set. During the trials the contract speed of 21 knots was, we are informed, exceeded. There was, we learn, no vibration, and although the ship is a coal burner, the combustion was quite satisfactory. The ship has been constructed under the supervision of Captain J. W. Harris, chief marine superintendent of the London, Midland and Scottish Railway Company, and Mr. A. T. Cotton, the company's superintendent engineer.

The Late Edward Le Bas.

MANY of our readers will learn with regret of the death of Mr. Edward Le Bas, who died suddenly on June 7th. He began his business career at the Great Western Railway Company's offices at Weymouth, eventually coming to London to join the firm of G. W. Share and Co. In 1890 he opened business on his own account as Edward Le Bas and Co., iron, steel, and metal merchants and agents. The business, which was at first confined to home trade, grew rapidly, and a very large business was done in both import and export with the Continent and, later, with America. The export business with Australia, Canada, Egypt, Mexico, and China was an important branch of the business. In 1900, large waterside premises were taken at Millwall to carry stocks and to begin manufacturing, the works eventually being equipped as an engineering shop chiefly connected with tubes, fittings, and pipe work. In 1905 Mr. Le Bas saw the possibilities of steel sheet piling, which he introduced into this country in so successful a manner that works were taken at Greenwich under the title of the British Steel Piling Company. The company transferred eventually to much larger works at Claydon, near Ipswich. Mr. Le Bas was chairman of many other companies. He was a member of the Court of the Worshipful Company of Ironmongers, and was one of the older members of the London Metal Exchange.

Major Douglas's Social Credit Plan.

By W. H. COATES, Ph.D.

No. I.

OUR ECONOMIC SYSTEM.

Foreword.

MONETARY theory lends itself to no final test. In this it is entirely different from the physical sciences. For example, money is concerned with the actions and reactions of men and women, animate persons, whereas the engineer deals with inanimate objects. Tests applicable to the latter are not possible with the former. In one case, all the variables but one in an experiment can be controlled; in the other, that method is not feasible. So the study of money must in the main be abstract, though it may be fortified by observations of fact in a kaleidoscopic world of different countries, varying legal systems and customs, changing units and alternating policies pursued by rival authorities. There is a multitude of books on money; nevertheless, finality is yet to seek. It is therefore not surprising that at all times of economic distress many are found to challenge existing monetary systems or methods. It is right to do so, for while age is entitled to respect, it is not necessarily a guarantee of perfection. Those who challenge established theories and practices founded thereon should, however, at least formulate their rival theories in a complete logical form, building up the structure by closely reasoned arguments, step by step, so that the articulation may be apparent and open to full examination and criticism. Extraneous observations should be eschewed, cheap sneers which weaken and not strengthen a case should be scorned, and unproved accusations which alienate sympathy should be beneath the dignity of any serious reformer.

Major Douglas, in expounding his theories, satisfies neither these positive nor these negative tests. The serious student finds no closely reasoned and complete body of argument, and in his search for truth he is as constantly wearied by irrelevant statements as he is offended by thoughtless and unproved accusations. So the task of the critic is not easy and the patience of the reader is likely to be strained.

Money in an Exchange Economy.

Orthodox writers on economics are not unanimous in regard to the more recondite effect of monetary action, but they are agreed on certain fundamental points concerning not only monetary but economic phenomena and without some clear understandings in this field it is difficult to set out the fallacies of the Douglas theory. A rough sketch is therefore offered of our economic and monetary system as a background against which the social credit theory may be examined.

Modern civilisation rests largely upon the simple principles of the division of labour and the mutual interchange of goods and services arising from human effort. As producers, most of us specialise, whereas as consumers we generalise. The bridge between specialisation and generalisation is exchange. The principal function of money is to effect these innumerable exchanges on terms satisfactory to each party. Every transfer of goods or services from one person to another creates a debt which must be satisfied by a like transfer in the other direction. The settlement of a debt may be immediate or deferred. Money facilitates both methods. In the early development stages of an exchange economy, money is almost always in a tangible form with a value of its own. Various commodities have been used by several peoples at different times, but by common consent two metals have proved supremely qualified for this purpose, namely, gold and silver, of which the former has won preponderant world support. In the development of the exchange system it has been found that, with the growth of confidence and understanding, tangible money may be replaced by other instruments, of which the chief forms to-day in industrial communities are notes and cheques. Instruments of this kind are a promise by someone to pay something; that is, they are evidence of a debt from the promisor to the promisee. The banking system as it has evolved has proved a potent method of enabling a debt to be satisfied by the offer to and acceptance by a creditor of a debt by a different debtor. The banker, therefore, may be said to deal in debts, in that he will receive monetary resources from anyone and owe that person a debt in return. In consequence banking facilities have led men to keep a stock of such debts in the form of deposits at a bank, which may be broken up and drawn upon bit by bit for the purpose of transferring the debt of the banker from the original owner to another person at the request of that original owner. A deposit at a bank gives any person the right to instruct the banker to transform the debt he owes to A. into a debt owed by the banker to B. By this means an obligation from A. to B. is satisfied.

Central and Commercial Banks.

The general public uses the banking system, so far as it is composed of commercial or deposit bankers, mainly for the purpose of settling debts among the members of that public. It is convenient also that the commercial or deposit bankers themselves should have a special bank of their own for the purpose of settling the debts of bankers between themselves, and such banks are commonly called central banks. Both commercial banks and the central bank are creations under the law, but a central bank is usually a particular creation with fixed rights and powers, and normally, either by custom or by particular statute, limited in its dividend paying power. In many countries any balance of earnings above a fixed rate of dividend enures to the benefit of the State. In the United Kingdom the dividends of the Bank of England, our central bank, are limited, not by law, but by custom, because the bank does a certain amount of commercial banking, but the profits arising from certain statutory powers accrue, not to the stockholders of the bank, but to the national Exchequer. The chief privilege granted by a State to a central bank is the power to control the note issue of the country, and in particular to issue a quantity of bank notes in excess of its current holding of hard cash assets of gold and silver. Any such excess has no backing of tangible monetary substance. It is a fiduciary issue supported usually by assets consisting of Government securities.

Note Issue.

The weekly return of the balance sheet of the Bank of England is issued in two parts, one concerning the bank notes, viz., the issue department, and the other the general banking business for the State and commercial banks, viz., the banking department. A *pro forma* balance sheet of the issue department of, say, the Alpha Central Bank operating like the Bank of England, the profits arising on which belong to the State, may therefore be drawn as follows:—

Alpha Central Bank, Issue Department.

	£ millions.		£ millions.
Bank notes:		Government securities covering the fiduciary issue	26
(*a*) In circulation ..	39	Gold	19
(*b*) In the Banking Department	6		
	£45		£45

It will be observed that the total note issue divides itself among notes in circulation and notes in the Banking Department. The total note issue can only vary (because the fiduciary issue is fixed—in the example above—at £26 million) by movements in the amount of gold. Such an increase or decrease reflects itself in corresponding movements in the amount of notes in circulation or in the Banking Department. Let us look at the corresponding Banking Department section of such a central bank's balance sheet.

Alpha Central Bank, Banking Department.

	£ millions.		£ millions.
Government deposits ..	2	Government securities	5
Bankers' deposits	10	Discounts, &c.	2
Capital and reserve ..	1	Bank notes	6
	£13		£13

The entry among the liabilities in respect of bankers' deposits finds its reflection, naturally, in an asset in the balance sheet of the joint stock banks. The above figures, therefore, need to be completed by a *pro forma* summary of the corresponding balance sheets of the commercial banks.

Commercial Banks.—Aggregated Balance Sheets.

	£ million.		£ million.
Deposits	120	Cash in tills	2
Capital and reserves ..	12	Cash in Alpha Central Bank	10
		Cash at call with bill-brokers, &c.	8
		Loans to customers ..	60
		Investments	24
		Discounts	23
		Premises	5
	£132		£132

Bank Creation of Money.

When a fiduciary issue is entrusted to a central bank by Statute, the notes so authorised find their way into circulation. The general public will deposit some of the notes with the commercial banks, which will retain part in their tills. The rest of the notes will be deposited by the commercial banks in the central bank and form a reserve. The key-note of any balance sheet is that the two sides of the account balance. Any addition to one side must be met by an equivalent increase on the other. No one will refuse to accept a cheque from a long-established central bank which enjoys confidence. It follows that should the central bank buy a new asset and pay for it by its own cheque, the following tendencies are set up. The cheque will be deposited by the seller of the asset with his own commercial bank, and that commercial bank will deposit the moneys so received with the central bank. Then bankers' deposits at the central bank on the liability side of its balance sheet will have increased by an amount equal to the increase in assets.

Every change in the bankers' deposits at the central bank affects *pro tanto* the amount of cash in the possession of the joint stock banks. Now these banks, while governed in certain respects by the law, are not in the United Kingdom restricted within precise limits in respect of the ratios between different items on the balance sheet. The position is governed by well-established practice which has been derived from experience over a long period. There are two principal ratios. First, commercial banks will not customarily allow the ratio between the amount of their coin, notes and balances with the central bank and the amount of their deposits to fall below 10 to 100. In the second place, they will not allow the ratio between loans to customers and their deposits to rise much above 50 to 100. Within these limits, namely, these two ratios and the amount of their cash, which, in turn, depends upon the operations of the Bank of England, the commercial banks can create or destroy money in the form of bank deposits. People will accept as money a cheque of a commercial bank drawn upon its account at the central bank. When these banks, therefore, purchase a new asset and pay for it in that way, they first deplete their balances at the central bank, but when the seller of the asset pays the cheque into his account with the commercial banks, their cash balances are restored to the original amount. They will not, however, infringe their own conventional rules as to the ratios concerned. An increase in assets, *e.g.*, investments, or additional premises, therefore, increases deposits. A new loan has the same effect. A decrease operates in the same way. Any net increase or decrease in assets thus necessarily increases or decreases the deposits of the whole banking system, and to this extent it is true that banks create or extinguish money. More or less money is in existence than was before. But there is a distinct limit to this process, governed by the ratios stated, in the first place, and ultimately, and more importantly, by the control which the central bank is able to exercise, through its own purchases or sales of assets, upon the total amount of cash in the hands of the commercial banks. It is essential fully to understand this mechanism, for it is one of the central points round which Major Douglas's theories crystallise.

Limit to Money Creation.

In determining its own policy, the central bank is inevitably governed by the necessity of maintaining stability of the purchasing power of the national monetary unit in comparison with the purchasing power of foreign monetary units. This relation is expressed through the rates of exchange between the various monetary units. The importance of such stability is obvious when regard is had to the enormous volume of foreign trade carried on by this country, trade which, while it may be expressed mainly in sterling, necessarily affects both sterling and the national currency of the foreign buyer or seller. If too much or too little credit is created by the banking system, the value of a national money in terms of foreign currencies will fall or rise. It is the task of a central bank to prevent this by its control over the commercial banks' balances of cash in the manner described.

Savings or Capital.

A brief explanation is now necessary in respect of savings, which represent—in real terms—some physical goods which have been produced during any given period as an excess of the amount of goods produced over those consumed. To be savings, such an excess should be in the beneficial ownership of a final consumer of that class of goods. In the simple case when Robinson Crusoe had maintained himself during a year, kept his existing equipment in its original condition, and had, in addition, built with his own labour a boat, then that boat may truly be said to represent his savings in that year. Real savings must express themselves in a physical form, and in our complicated economic system of to-day, the durable goods which represent them spring from the effort of all who have co-operated in their production, for the cost of maintenance of all these co-operating workers is paid for by the savings of those who desire to own the goods. It makes no difference that all manner of workers—farmers, shipowners, railways, financiers, insurers, directors, foremen and labourers—have each contributed a small quota to the work of producing these new capital assets. In sum, they represent solidified consumption. Every contributor must be housed, clothed and fed, normally amused, educated, and so forth. As the equipment is to be durable it obviously cannot meet these needs itself. The consumption demands of those engaged upon the task must be satisfied out of the current production of such consumption supplies. Persons who would have been otherwise able to buy and consume those supplies have refrained from that act in order that those engaged on the

long series of operations concerned in the task may be maintained.

MONEY A CONVENIENCE, NOT A NECESSITY.

This process can function in a very simple economy, such as that used by Robinson Crusoe and Man Friday, without any monetary means. In modern civilisation money facilitates this process, but it is not a necessary ingredient. The money used is a convenient method by which goods and services are exchanged for one another. The existence of money does not create the goods or services, for they could be produced without its aid.

While in practice manufacturing operations are carried out by a very large number of different producing units in the form of private businesses, whether sole or partnership traders, and public concerns, namely, joint stock companies, or local or central government authorities, there is no reason why all the productive operations should not be regarded as carried on by one unit. In such a case all the human effort necessary for production is seen to be of a co-operative nature, each individual doing his allotted part under the principle of the division of labour. We can imagine a concern producing motor cars which possesses sufficient areas of land to provide all the natural resources necessary for this manufacture. It may own coal mines, copper mines, and tin mines, from which it derives these products, and the necessary farms for the production of food for the maintenance of its workers and in order to obtain supplies of clothing, leather, timber, and so forth. Equally, the concern may possess its own steel works, non-ferrous metal works, glass works, and any other plant and machinery necessary for its purpose.

Given the requisite co-operation among all the human beings engaged in this co-operative enterprise; given adequate supplies of food, clothing, and shelter, and the necessary facilities for recreation and amusement, it will be clear that at the end of a year the whole community could have lived in the ordinary manner and be in possession of the stock of cars which had been made. A series of intricate internal exchanges of goods and services would necessarily have taken place, and in order that equity may be done between the different persons concerned, it may be that records of each man's efforts would have been needed in order to divide the total of consumption supplies available in proportion to individual merit. Even that would not be essential, for all might have consented to share alike. The point, however, is that all these individuals could have lived in comfort, and, by their efforts in producing more than they had consumed, found themselves in the possession of certain capital or savings, namely, the motor cars manufactured during the year, without the use of any money. If we imagine another concern managed on similar lines, but devoting its efforts to some other product, say, ships, it would be in a like position at the end of the year, except that its savings would be in the form of ships. Assuming that the two enterprises can agree upon a ratio of exchange, then each may transfer to the other some of its saved capital products and a bargain be done in terms of ships and motor cars. Here we have barter without the intervention of money.

Now the fact that in real life the enterprise of building motor cars or ships is divided over a very large number of concerns situated, maybe, in different parts of the world, does not affect the essential principles involved, but it is clear that the use of money for the purpose of dividing consumption supplies among productive workers in some reasonable proportion to their relative efforts facilitates the process of these operations. Indeed, human nature being what it is, it is only the intervention of money for this purpose of exchange on equitable terms and conditions that makes the principle of the division of labour work to the degree that it does. So we have the timber that is found in the motor car being produced in America, the copper mined in Rhodesia, the tin dredged in Malaya, the leather grown on beasts in the Argentine, the steel fashioned in Sheffield from ore obtained from Norway, and so forth; only monetary mechanism could have led to this minute subdivision of co-operative industrial efforts.

ROUNDABOUT PRODUCTION.

Carrying the process one stage further, it is clear that while motor cars and ships are durable assets, that is to say, they are not consumed in one operation like an orange, they nevertheless do not endure permanently. Their utility serves over a period shorter in the case of cars than of ships, but both ultimately wear out. In the production of a complex final article of this kind, it is obvious that there must be some order, method, or arrangement in the various productive operations which lead up to the finished article. Coal, for instance, must be mined to-day for use in the furnace next week, in order that pig iron may be produced later, which in its turn will be converted into billets of steel for machining subsequently into crank shafts and so forth. The mind's eye may see this series of operations strung out one after another, and number them for convenience 1, 2, 3, 4, 5. But inasmuch as the whole cycle of operations is to be continuous in order to provide for the renewal in due course of worn-out products, there will be not one series running 1, 2, 3, 4, 5, but a number of series. Moreover, like stages will not all be occurring simultaneously, but in cyclic order, *e.g.*,

	Units of time.				
Series.	*a.*	*b.*	*c.*	*d.*	*e.*
	Stages.				
A	1	2	3	4	5
B	2	3	4	5	1
C	3	4	5	1	2
D	4	5	1	2	3
E	5	1	2	3	4

The workers in an enterprise may be eating food to-day, the production of which may have commenced one year or two years earlier. The engineer machining a crank shaft will be working on a material, the first stages of which took place long before. Given the right balance between the different operations in a long and complex series of this kind, the respective series of operations can be conducted in unison with one another in a continuous manner over a long period without any hitch, so that year by year, at the close of the year, a new stock of products, be it motor cars or ships, or anything else, is emerging in a regular and orderly fashion. Reduced to smaller periods, such finished products can emerge each month. Again, given sufficient co-operation, understanding, and willingness, between the individuals concerned, there is nothing inherent in this orderly method and arrangement which requires essentially the intervention of money as an instrument of exchange. Year by year sufficient consumption goods could be produced and consumed and the stock of durable goods may multiply.

(To be continued.)

King George V Graving Dock, Pumping Plant and Equipment.

No. II.

(Continued from page 585, June 7th.)

PUMPING PLANT (*continued*).

Valves.—It will be seen from Figs. 3 and 7 (*ante*) that a number of large valves have to be employed so as to arrange the flow of water for the various functions for which the pumping machinery is employed. These valves were manufactured by Glenfield and Kennedy, Ltd., of Kilmarnock, and comprise eleven 10ft., six 6ft. 6in., and five 3ft. diameter sluice valves external to the pumping station. In order to obtain operation of these valves from the control platform, they are all electrically driven by separate motors.

The 10ft. and 6ft. 6in. diameter valves are generally of similar design, and it will be sufficient to illustrate and describe one unit, which is typical of the others. As shown in Fig. 9, each of these valves is installed in a separate well. This drawing particularly applies to Nos. 7, 8, 12, and 13, which are suction

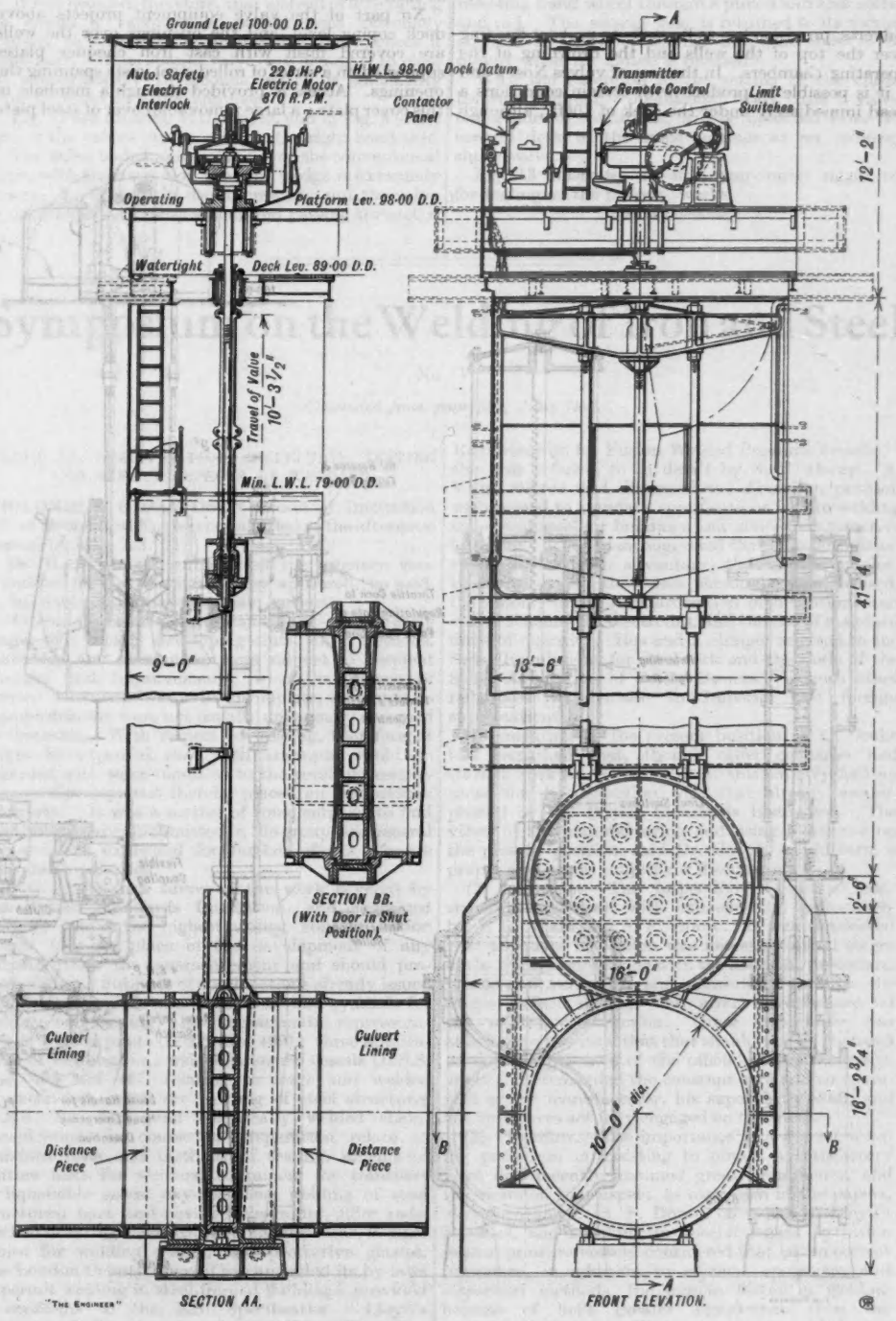


FIG. 9—ARRANGEMENT OF MAIN SLUICE VALVES

valves, the others differing mainly in the depth below coping level. It is interesting to note that some of the valves are situated with their inverts at a depth of 70ft. below this level.

Since, owing to the working conditions it is possible to produce comparatively high pressures in these

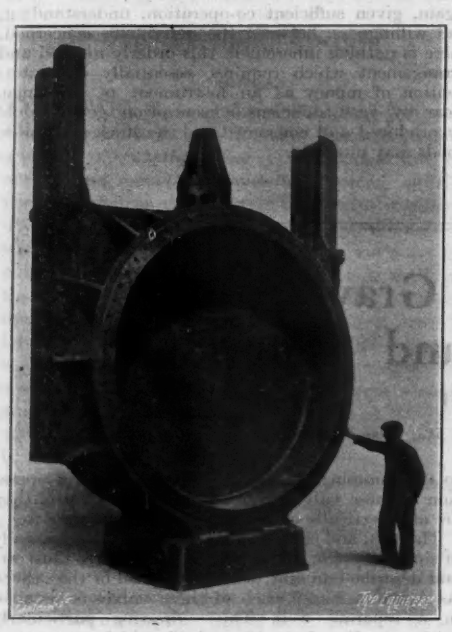


FIG. 10—10-FOOT DIAMETER SLUICE VALVE

culverts, provision has to be made to prevent flooding over the top of the wells and the drowning of the operating chambers. In the case of valves Nos. 2 and 3 it is possible to produce with certain conditions a head immediately under the deck of 106ft., although these particular valves are installed with their centres only 33ft. below coping level. All these valves are designed to operate with hydraulic pressure on either side of the wedge. To meet the requirement referred to there is in each valve pit, a short distance below the operating gear, a water-tight reinforced concrete deck through which the valve-operating screw passes by way of a packed gland. The reinforcement in this deck consists of a network of rolled steel girders built into the concrete at each side, from which is supported the main box girder carrying the operating gear to which the whole of the operating load is transmitted. These girders are also built into the concrete at each end.

No part of the valve equipment projects above dock coping level, and the openings over the wells are covered flush with cast iron chequer plates supported on a series of rolled steel joists spanning the openings. Access is provided through a manhole in this cover plate; a large removable cover of steel plate is bolted to prepared faces on the girder framework of the water-tight deck to allow the whole of the valve to be dismantled and taken out of its well, should this ever be necessary at some future date. The covers for this purpose on the 10ft. diameter valves measure 13ft. 6in. long by 2ft. 7½in. broad.

A manhole is also provided in the water-tight deck for access to a low-water platform, from which the screw nut and underwater working parts can be inspected at low tide.

FIG. 12—OPERATING GEAR OF SLUICE VALVES

The valves are constructed of high-grade cast iron, and provided with zincless-bronze faces recessed and held in position on the door and frame by means of countersunk screws. Zincless-bronze is used for underwater parts to prevent electrolytic action in the sea water.

Each of the four faces of each valve was accurately machined and hand scraped to a perfect fit in the shops, to ensure water-tightness with pressure in either direction. In order to ensure that this fine

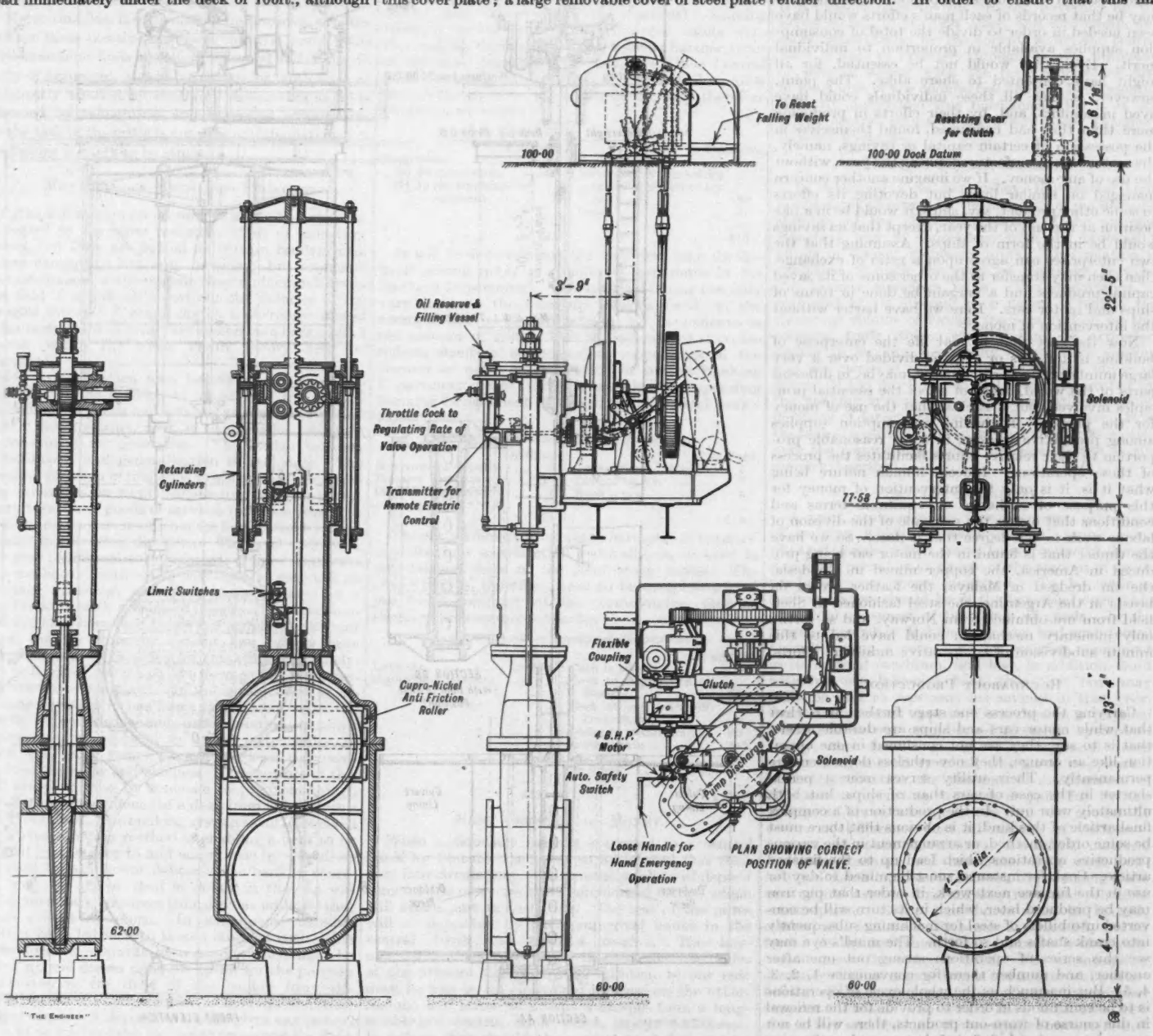


FIG. 11—DISCHARGE VALVE FOR MAIN PUMP

adjustment would be maintained after erection at site, it was essential to construct the valves of exceedingly robust section with the parts of the body well ribbed.

Each valve is constructed with the body in four parts comprising two side members joined by tapered sections to facilitate dismantling, should this be required after the valves have been installed, with their end flanges bolted to sections of the culvert lining which are built in to the concrete. After unbolting these double-tapered sections, they can be lifted out and the two end frames drawn away from their companion flanges.

The valve body is mounted on a heavy cast iron base plate, on which are fitted adjustable screw stops which meet suitably prepared faces on the valve door, and were adjusted at the time of erection to prevent the door becoming wedged in the closed position.

Extensions at each side of the valve body are fitted with bronze channels, and corresponding projections on the door are faced with bronze to take the bearing load as soon as the valve has been released from its face.

From the valve door two mild steel rods lead up to a compensating crosshead running between cast iron machined guides bolted to the walls of the chamber, and operated by a mild steel screw and gun-metal nut at the centre of the crosshead. The gearing consists of spur and worm reduction units totally enclosed and running in an oil bath, all having machine-cut teeth. An indicator of the fine screw and pointer type shows the position of the door, and operates the limit switches, cutting off the current at the extremes of the valve travel.

Each of the valves is provided with an electrical transmitter for indicating its position, as described below. This transmitter is operated through bevel and spur reduction gears from the top of the main worm wheel.

Each valve is operated by an electric motor

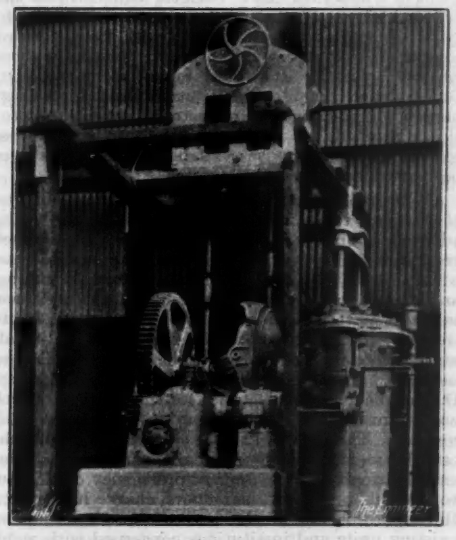


FIG. 13—DISCHARGE VALVE FOR MAIN PUMP

supported with its journal bearings on substantial box-form bed-plates. Emergency hand operation is provided for use in the event of current failure. Two crank handles are fitted to the squared ends of the motor shaft on each of the 10ft. diameter valves, and the normal effort which is required on each of these handles to open the valve under full unbalanced head is 28 lb. The speed of operation by electric motor is 15in. per minute.

Special attention has been given to the lubrication of the underwater working parts, comprising the operating nut and guide bearing. Individual pipes lead from an automatic grease pump through the water-tight deck to supply these points. In the case of the guide bearing the pipe run was straightforward, but for the rest jointed pipes were fitted to accommodate the necessary movement.

Fig. 10 shows one of the 10ft. diameter sluice valves. A photographic view of three sets of the operating gear erected on their supporting beams is given in Fig. 12. From this engraving it will be noticed that all parts of the equipment are of a very robust nature to ensure long life with frequent use, and to require a minimum of maintenance.

The weight of each of the 10ft. valves, exclusive of gearing, is 45 tons, and the transport of these large units from Glenfield and Kennedy's works in Kilmarnock to the site necessitated the use of special low-loading trucks of the crocodile type.

Air which accumulates below the water-tight deck is released by double air valves installed just below coping level and connected to the valve well by a 4in. pipe. Open chequer plate grids are mounted over the air valve chambers, flush with the coping. One chamber of the air valve is provided with a rubber-covered wooden ball, and a small orifice to release accumulations of air under pressure, and the other chamber has a vulcanite-covered ball and large orifice to release air at low pressure when the well is filling with water, or to admit air to the well when the water level is falling.

Each valve is operated by an electric motor of the squirrel-cage, dripproof type, made by Lancashire Dynamo and Crypto, Ltd., specially impregnated against damp and working on a supply of 415 volts, three-phase, 50 cycles.

Provision is made to prevent power operation of the valves when the handles are in position. This takes the form of a cover over the end of the spindles under which the handles have to be fixed. When this cover is open a switch incorporated in the cover breaks the control circuit of the starter.

Pump Valves.—Each pump is provided with a sluice valve on the suction and on the delivery branch. In general, these are of the standard wedge type construction, with zincless-bronze faces, and with extension operating rods transmitting the power from the headstock situated at motor floor level. The main pump valves are electrically operated, and the discharge valves of the drainer pumps are also driven by electric motors.

Discharge Valves for Main Pumps.—These are of special interest as they combine self-closing features with the function of a normal sluice stop valve. It will be noted from Fig. 3 (*ante*) that there is a common discharge culvert for each pair of the main pumps. It therefore became inadvisable to use the conventional type of reflux valve, even of the multi-flap type, as it was calculated that serious slamming of the flaps would occur in the event of one pump being stopped whilst its neighbour continued to run. The reason for this is that the reversal of flow through the reflux valve would be so rapid that it would be impossible to design flaps which could close before the reverse velocity had momentarily attained a high value. Consequently, when the flap did return to its seating, it would be moving at such a high velocity as to cause severe slamming and possible damage.

It was decided, therefore, that instead of attempting to design a valve which would close extremely rapidly, to permit the reversal of flow and to check it gradually. These special valves are arranged to close in approximately 15 seconds, which is sufficiently slow to avoid all water hammer.

Fig. 11 is a drawing of the valve, and in Fig. 8 (*ante*) one of the valves can be seen on the right-hand side.

The valve bodies and wedge are of the conventional type, with the exception that the wedge is extremely heavy. Instead of the usual screw and nut the valve is operated by a bronze sliding rod passing through a gland and attached to a steel rack housed within a cylindrical casting. Engaging with the rack there is a pinion directly coupled to a large friction clutch, through which the power is transmitted *vid* suitable worm and spur reduction gearing from an electric motor. Under normal conditions of operation this clutch is continually engaged and the valve opened and closed by means of the electric motor.

Should the pump stop running or any other circumstance occur in which it is necessary for this discharge valve to be closed quickly, the clutch is released by the falling of a weighted lever—Fig. 11—and owing to the great weight of the wedge the valve automatically closes. The weighted lever is retained normally in its highest position by a pawl held in engagement by a solenoid and two links.

This solenoid is energised at all normal times of operation, but when the valve has to be closed quickly is de-energised by the interlocking system described below, in addition the arrangement being such that the valve cannot be opened when the corresponding pump is stopped. A crosshead is fitted at the top of the rack, having two piston-rods working in cataract cylinders which control the speed of closing by passing the oil from the bottom of the cylinders to the top through an adjustable regulating valve and common pipe.

It will be seen from Fig. 11 that the wedge is guided by cupro-nickel anti-friction rollers so as to ensure that it will close by gravity against the maximum possible unbalanced head of 70ft. of sea water.

When the plant is being started up the valve clutch is set from the motor floor level, as soon as the supply is available to energise the solenoid, by the following operation :—

The hand lever is raised, which, in turn, raises the weighted lever by means of a rod, and as the solenoid is energised a pawl link is brought into engagement with the retaining face of a cam by a spring. The clutch is now engaged by rotating the resetting hand wheel through a pinion and spur sector and rod. The setting gear is returned to its normal position by gravity, leaving only the rods to be moved when the clutch is released.

With the exception of the setting of the clutch before pumping operations start the valve, under normal conditions, will be operated from the control desk in the same manner as an ordinary sluice valve.

Fig. 13 illustrates a valve temporarily rigged up for testing at the makers' works.

(To be continued.)

Symposium on the Welding of Iron and Steel

No. V.

(Concluded from page 600, June 7th.)

GROUP IV.—SPECIFICATION, INSPECTION, TESTING AND SAFETY ASPECTS OF WELDING.

COLONEL A. E. DAVIDSON (President, Institution of Mechanical Engineers) presided at the afternoon session on May 3rd.

Dr. H. J. Gough summarised the nineteen contributions in this Section. They appeared, he said, to fall naturally into eleven main aspects.

(1) *Standardisation and Specifications.*—In the early stages of a rapidly developing craft, when methods, materials, and plant alike were subject to frequent changes and improvements, when experience of service behaviour was still incomplete, attempts at standardisation were not usually universally accepted as desirable. With respect to welding, therefore, it might be expected that such attempts would be regarded with some doubt as to the resulting restriction on development thereby placed on competitive enterprise. It was a matter of some surprise to find that, in the papers submitted in the group, the general demand was expressed for further efforts towards such standardisation.

J. O. Cooke had surveyed the work covered by the British Standards Institution, and suggested that, to attain the highest utility, standardisation should take its place in the development of any industry from the commencement and should progress with it. Subjects of specifications already issued include : Nomenclature, definitions and symbols for welding and cutting, also diagrammatic representation of welded joints (B.S.S. No. 499) ; three applications of welding, *i.e.*, welded pressure vessels (B.S.S. Nos. 428 and 487, relating to forge and welded air receivers), metal arc welding of steel structures (B.S.S. No. 538), and electrically welded chain. Specifications in course of preparation relate to standard tests and methods of testing, scheme of routine tests for welders, containers for transport of liquefiable gases, oxy-acetylene welding of steel structures, bare and covered electrodes, filler rods, method of rating electrical welding apparatus, flexible cables for welding plants, and protective glasses. The London County Council has amended its by-laws to permit welding in steel-framed buildings, provided it conforms to the B.S. Specification. Lloyd's Register of Shipping issued, in 1934, "Tentative Requirements for Fusion Welded Pressure Vessels" ; this was referred to in detail by S. F. Dorey. A. Vogel related and discussed the American position with regard to standard specifications for arc welding structural steel for buildings and invited constructive criticism. J. L. Adam suggested that standardisation could reduce, with advantage, the number of electrodes used, and that sizes should be standardised. O. Simonis urged standardisation of definitions and colour schemes for electrodes, and the use of standard units of quantity. Ros and Eichinger referred to the Swiss Regulations for steelwork and the Code of the Swiss Association of Boiler Owners. Various other references were made to Imperial and foreign specifications.

Commenting on the present position, J. O. Cooke had remarked that, though other countries had started work at an earlier date, this country had no cause for dissatisfaction with that already accomplished by the British Standards Institution. The views of the manufacturing and using industries on the present position, said Dr. Gough, would form a proper and useful subject for discussion.

(2) *Inspection.*—The inspection of welded construction was dealt with exhaustively, particularly by J. L. Adam and S. F. Dorey. It was considered that adequate inspection was necessary at all stages of the work, commencing with the material, procedure, plant, and *personnel*, and continuing through the stages before, during, and after manufacture, of the welded construction. Great importance was attached to the view that that should not be regarded as the sole province of the official inspector or surveyor, but demanded the constant care and co-operation of the manufacturer, his supervisory staff, and the operatives actually engaged on the work.

(3) *Procedure.*—The importance of a correct welding procedure in assisting to obtain a satisfactory joint had recently assumed great prominence, and the views on that aspect, as expressed in the papers, were mentioned. S. F. Dorey, on behalf of Lloyd's Register, and speaking in special regard to fusion welded pressure vessels, considered that, given correct procedure, in addition to efficient operatives and inspection methods, the human factor in welding became of little greater significance than the mechanical factors. With regard to welded ship

construction, the views of the British Corporation Register of Shipping and Aircraft, as expressed by J. L. Adam, were equally authoritative; in presenting the approved procedure he remarked that in the present absence of reliable non-destructive tests, control of procedure, allied with visual inspection, were the only means at the disposal of the surveyor. The specification for procedure must be complete, as results obtained from imperfect specifications might vary widely. On the other hand, experience had shown that rigid adherence to the procedure specified for each joint ensured a remarkable consistency in the structure of the welds. The importance attached to procedure in American specifications for welded structures was shown in a paper by A. Vogel. W. D. Halsey recorded the firm belief that, when certain materials were placed in the hands of an operator who was required to follow a certain technique of welding, that procedure removed entirely from the control of the operator the determination of the tensile strength and ductility of the welded joint, provided that the operator obtained a clean weld properly fused to the base metal.

(4) *Heat Treatment of Welded Joints.*—That such heat treatment was desirable, if practicable, was generally accepted. H. E. Pollard stated that failures had occurred, owing to internal stresses resulting from lack of heat treatment. S. F. Dorey favoured normalising, but recognised that distortion trouble might be involved. Dorey, with Ros and Eichinger, had found slow cooling from 600 deg. Cent. beneficial in reducing internal stresses; the last-named authors stated, however, that internal stresses were dangerous only when of very high intensity or after actual cracks had formed, and they cited experiences showing that stresses tended to be relieved in time.

(5) *Testing.*—The importance attached to testing and correct testing methods was shown by the fact that copious reference to that aspect occurred in nearly every paper submitted. (Dr. Gough dealt with some of the points made under three separate sub-headings.)

(*a*) *Mechanical Tests: Static and Impact.*—As a first step, it was the general practice to apply a group of tests whose primary object was to examine whether the electrode or filler rod was suitable for its purpose; a list of such tests included all-weld-metal tensile and bend tests, ductility tensile and bend tests on simple welded joints, fillet shear test, cruciform test, Charpy, Izod, and tensile impact tests, &c. (sometimes including fatigue tests on all-metal specimens and on simple welded joints). Some doubts were expressed by authors regarding the value of tests on all deposited metal and the fillet shear, cruciform and impact tests; the experiences submitted showed that there was as yet no uniformity in the various test schemes adopted or forms of specimen used; general agreement, however, was expressed that when an electrode or rod had emerged satisfactorily from such a system of tests, the type could be accepted. In the next stage, the tests were dictated by the point of view. Some still regarded the human element as all-important and made tests on welded joints to test a particular joint and the operator concerned. An increasing body of opinion, however, designed a series of tests on joints similar to those used in service, to investigate the correctness of the procedure, in relation to the weld metal, in producing a sound joint; tests employed included bend tests of various types, tensile tests on butt welds, and shear and tensile tests on fillet welds. Detailed discussions on those points, and mention of various less well-known forms of tests and specimens, were found in the papers by S. F. Dorey, J. L. Adams, W. D. Halsey, and M. Ros and A. Eichinger. Given approved electrodes, procedure, and welding plant, efficient inspection at all stages of manufacture was very necessary, together with occasional mechanical tests on sample joints. The latter were few in relation to the total amount of welding involved; a typical example was given by J. L. Adam of shipwork, where 100ft. of sample welding represented 150,000ft. in the ship (less than $^1/_{16}$th of 1 per cent.).

(*b*) *Fatigue Tests.*—A significant feature of the group was the evidence of the experimental attention now being devoted to the resistance of welded connections to cyclic stresses; O. Graf, B. P. Haigh, G. A. Hankins, A. M. Roberts, O. Bondy, and Ros and Eichinger made contributions on that aspect, which was also repeatedly referred to in the other papers. That was no chance occurrence and the underlying reason should be realised; it was due simply to the powerful influence on the resistance to cyclic stresses caused by local stress concentrations produced by sudden changes of section, cavities, and internal flaws; to such, welded joints were, by their very nature, inherently susceptible. The seriousness of the problem in design was evidenced by the experimental values of the effective resistance of welded joints to repeated tensile stresses given in the following table. In view of these values, the statement by J. L. Adam, that alternating stresses of 7 tons per square inch were quite common in ship's structures, assumed considerable significance.

O. Graf had carried out his work using a fatigue machine of 197 tons capacity, while machines of 50 to 60 tons capacity were quite common in Germany. The largest commercial fatigue machines made in this country had 7 tons capacity; thus the examination of large welded joints, by fatigue tests, had been confined to foreign countries. Dr. Gough regarded that position as serious, and said that until it was remedied major reliance, for design purposes, must be placed on the German and Swiss results. All investigators agreed that the static tensile strength of a welded joint was no indication whatever of its fatigue resistance. O. Graf had shown that rough cover plates, attached by fillet welds, actually weakened a butt joint; his fatigue tests on composite beam structures showed that the best form of welded joint was revealed by a repeated tensile fatigue test. In butt and fillet welds alike it was important to provide gradual transitions of section, smooth surfaces, and proper penetration. Some interesting tests by B. P. Haigh demonstrated that inclusions and cavities were largely responsible for the low fatigue resistance of welds. G. A. Hankins had shown that, in addition to the effect of flaws, stress concentrations at fillets and rough surfaces in fillet and butt welds brought about further reduction in fatigue strength; the quality of electrode used also had an important influence. A. M. Roberts had shown that sound low-carbon steel welds made by the metal arc, oxy-acetylene, atomic hydrogen, and resistance welding processes had approximately the same fatigue resistance; also, the mere presence of a transverse bead deposit materially reduced the fatigue strength of the strip on which it was laid. Figures were given for the relative fatigue resistances of a solid steel tee section (100 per cent.), an unchamfered fillet welded tee joint (72 per cent.), and a tee joint with edges chamfered before welding (84 per cent.). Bondy drew attention to the fact that the 1934 design regulations of German State Railways included a fatigue factor based on the ratio between the maximum and minimum forces induced in the members of a bridge; he had rightly contended that that design method was preferable to that in which an "impact allowance" was made merely in relation to the static load. With regard to the use of high-tensile steel for bridge construction, experience had shown that the fatigue strength of those steels had not been augmented in the same degree as their static strengths, a fact which was also taken into account in the German regulations for bridges. Ros and Eichinger had carried out a large number of fatigue tests, using large-capacity machines. They had shown that the strength of the fusion zone, in the neighbourhood of a weld, was lower than that of the parent metal. Joints consisting of diamond-shaped cover plates, connected by fillet welds, had the very low resistance to repeated tensile stresses of 6½ tons per square inch only, and were unsuitable as joints to withstand heavy fluctuations of load. The conclusion was unavoidable, said Dr. Gough, that in the design of welded constructions the fatigue aspect must be taken into serious consideration; also, that in the development of large welded joints, by fatigue methods, this country had, in the past, played no part. He had an increasing distrust of results obtained from very small specimens. Much further development work remained to be done. Was it also to be left to Continental workers?

Effective Resistance of Welded Joints to Repeated Tensile Stresses.

Investigator.	Type of joint.	Safe range under repeated tensile stresses, tons per square inch.	Number of cycles on which fatigue strength was determined, millions.
Graf	V butt welds (good)	15	2
,,	,, ,, (bad)	7½	,,
,,	Side fillet welds (good)	7½ to 9	,,
Haigh	V butt welds (bad)	9½	10
Hankins	X butt welds, covered electrode, machined	13½	20
,,	X butt welds, covered electrode, not machined	8	,,
,,	X butt welds, bare electrode, machined	4½	,,
,,	X butt welds, bare electrode, not machined	6	,,
,,	V butt welds, bare electrode, machined	4	,,
,,	V butt welds, bare electrode, not machined	5	,,
,,	Transverse fillet welds, covered electrode	7	,,
,,	Transverse fillet welds, bare electrode	4	,,
,,	Longitudinal fillet welds, covered electrode	6	,,
Ros and Eichinger	V and X butt welds, electric and oxy-acetylene	7½ to 9	1
,,	Long. fillet welds, electric	3½ to 4½	,,
,,	Transverse fillet welds, electric	4½ to 5	,,

(*c*) *Non-destructive Methods of Testing.*—R. Bernhard had reported that in German experience testing by X-rays was the most satisfactory method; it was largely practised in that country. Satisfactory X-ray apparatus had been evolved which could be used safely for potentials up to 300,000 volts. Success was claimed in the examination of structural and bridge work, and in several bridge works this test was a matter of routine; on the German State Railways X-ray examination of all the load-bearing parts of new welded bridges was said to be the rule. An extensive field for research into methods of testing welded joints, especially by X-rays, remained and German workers were busy in this field. Dorey had merely observed that experience had shown that X-ray and gamma-ray methods could be relied upon to reveal any serious void or crack in a butt-welded seam; such methods must be used for important pressure vessels. Hankins, discussing X-ray, magnetic, electrical, and accoustical methods, had remarked that their use was confined to the detection of such defects as inadequate fusion, lack of penetration, presence of inclusions, blow-holes, &c., of those methods, only X-ray examination appeared to have reached a practical stage in this country. The value of X-ray examination was said to be established, but its efficacy decreased rapidly with increase of metal thickness; the method was not readily suited to the examination of fillet welds.

From the somewhat diverse opinions and experiences recorded Dr. Gough concluded that either German development in that field was enormously ahead of that in this country, or, alternatively, that somewhat wild claims were being advanced. That important results had been obtained was widely known; and the psychological effect on the operator was admitted, and, to some extent, relied on. But he questioned whether the test, when applied to complicated shapes, could yet be deemed reliable, and also, for economic reasons, whether every welded part of a bridge could be submitted to X-ray examination.

Other tests of a "non-destructive" nature on a completed welded construction to which reference was made were the visual examination of small etched specimens removed from a weld by a hollow drill, and the exposure of the joint at the root of a seam by a conical drill.

(6) *Photo-elasticity.*—One of the biggest factors controlling the strength of welded joints lay in the stress concentrations set up by surface irregularities, flaws, cavities, &c.; for their examination, photo-elastic methods were particularly suitable. E. G. Coker had contributed analyses of transverse fillet and butt welds, with an interesting suggestion that X-ray and photo-elastic methods be applied jointly to the examination of butt welds in pressure vessels. Love had provided a new analytical treatment of the effect of a spherical flaw. Roberts demonstrated the different effects of existing flaws on the resistance to cyclic bending and direct stresses, with the important conclusion that direct stress fatigue tests were most generally useful. It would be realised, said Dr. Gough, that reliable quantitative data for design purposes could not be expected from the photo-elastic method, but it did give a picture of the stress conditions not otherwise available; design data were best obtained from fatigue tests.

(7) *Organisation and Training.*—The new technique of joining metals by welding processes was being adopted in many industries at a time when much greater scrutiny was given to any new process than was the case with its older rivals—riveting, casting, and simple forging. As one result, much had been said and written about placing all matters relating to welding under a central body. That raised a difficult and delicate subject, but one which arose directly and indirectly from some of the papers in the group. O. Simonis made a direct plea for the creation of such an organisation for the general control of welding matters. The duties of that body were to include the establishment of test standards and regulations, examinations, and the issue of proficiency certificates to welders, inspectors, surveyors, charge hands, &c., the co-ordination of the activities and actions of existing units and institutions concerned with welding, and the assumption of the full responsibility for the standardisation and unification of the welding industry as a whole. The opinions of the classification societies on that proposition would be particularly valuable and interesting. Cooke had discussed the case for the British Standards Institution, whose actions, in the opinion of Simonis, did not appear to have met the existing need. Adam discussed very fully the position of the classification societies with regard to the shipping industry, and their special responsibilities, both to the shipbuilder and the owner in ensuring that the best effect was given to the technical knowledge embodied in the rules and regulations of the societies, which were concerned with the quality of material, efficiency of connections, and standards of workmanship. He suggested that a classification society must not be a mere critic of workmanship, but must share or even lead in the development of structural design. Dorey, in a similar manner, described the extreme care and attention given to welded structures and pressure vessels by Lloyd's Register of Shipping. In addition to classification societies, the interests of the manufacturing welding industry and of the much greater group—the diverse industries which employ welding—had to be considered. Last and not least, the question whether the creation of a central controlling body, however elastic its organisation might be, would be in the best interests of the free and rapid development of the welding art should be considered.

Many references were made to the important problem of meeting the demand for trained operatives, charge hands, &c., which appeared at present to exceed the supply. Several excellent professional schools existed, controlled by firms representing the manufacturing or using industries. Again, many organisations had domestic arrangements for the training of their own operative and supervisory staffs. As pointed out by Adam, the training of both types was equally important, and he had mentioned that in

shipyard work the inadequate balance of qualified checkers to operators might lead to difficulties in the future, unless steps were taken to adjust the position. The technical training of welders was dealt with by D. H. Ingall and D. D. Stockley, and a suggestion was made for a somewhat ambitious scheme of a Central School of Welding which would not only provide full-time courses for operatives, charge hands, designers, and others, but would undertake research, stage welding demonstrations, and act as a meeting-place for discussions on welding matters in general by members of interested technical societies. In the last section of the paper it was announced that such a Central School was in existence, attached to one of the technical educational establishments. Whether such an establishment—presumably largely financed by the Board of Education—could properly, and with any hope of success, undertake the very wide range of activities previously outlined in the paper, said Dr. Gough, might be usefully discussed.

(8) *Design and Repair.*—It was generally agreed that, where possible, butt joints should be employed, and that welded joints of any kind should be placed at positions not exposed to severe stresses. Where a component was subjected to cyclic stresses, design should be governed by the fatigue aspect; rigidity of structure must receive careful attention. Dorey had pointed out that in engine entablatures the problem of welding *v.* castings was economic in nature. The devising of structural sections specially adapted for welding was needed. Bondy drew attention to special structural shapes and forms of joints which had been developed on the Continent, arising directly from extensive researches, and emphasised the need for further development. S. Bryla recorded two valuable investigations into the effect of welded reinforcement on the strength of structural beams. Welded stiffening ribs, attached under the loading points of I beams of various depths, produced increased economy in construction which was a function of the depth of the beam. More valuable design data were given relating to the relative strengths of riveted and welded plate girders. I beams, with or without plates, were much more efficient than plate girders; those of the former type lent themselves much more easily to welded construction, marking one of the great advantages to be achieved by such construction. Other experience on those aspects would be useful.

With regard to permissible working stresses in design, Ros and Eichinger submitted proposals for butt and fillet weld joints based on experimental fatigue results and analytical methods. Taking experimental values for the limiting values of such joints under three types of repeated stresses, and assuming the Mises-Hencky relation for failure under combined stresses, they obtained expressions and curves for the permissible stresses in both joints based on assumed values for riveted joints. Thus far, no exception could be drawn. The results were then extended to the general case of reversed, repeated, and pulsating stresses, assuming for the purpose an empirical relation between the superior and inferior stresses of limiting ranges. Dr. Gough suggested that it might be dangerous, in the absence of more experimental data, to assume that these relations might be worked to with confidence. Nevertheless, the quoted permissible stresses adopted by the Swiss authorities for gas cylinders, pressure lines and boilers, appeared to be on the safe side with regard to the recommendations of Ros and Eichinger.

In repairs or additions to existing structures by welding, the effect of shrinkage stresses was of great importance. The severity of those stresses had been demonstrated by A. M. Roberts and G. Ellson. Yet in an extensive investigation of actual girders, loaded and unloaded, Ellson had found that those stresses had little or no appreciable influence on the stress induced at failure under static loading of complete structures, such as joints and plate girders to which flange plates, flange strips, and web plates had been added, while their total resistances had been considerably increased. It might, however, be questioned if the resistance to repeated loading was also unaffected.

(9) *Failures in Service.*—F. E. Pollard, on behalf of the Home Office, discussed typical examples of service failures which were mainly due to insufficient weld penetration, faulty design of joint, and other component part, or the presence of internal stress due to lack of heat treatment. Many could have been avoided by adequate inspection before, during, and subsequent to manufacture. Ros and Eichinger listed typical causes of failure in Swiss experience. They drew particular attention to failures encountered in the welding of high carbon and alloy steels, adding that the fatigue strength of such steels was little better than that of soft structural steel.

(10) *Protective Devices.*—In the rapidly expanding use of a comparatively new process the care of the health and comfort of the operatives should be given the utmost consideration. That was especially true of welding, where the arc radiation contained a large proportion of ultra-violet and infra-red rays, which were extremely harmful to the eyesight; a false sense of security might arise from the use of any merely dark glass, which certainly cut down "glare," but was useless against the real danger. W. Watson had drawn attention to that important aspect, pointing out that really protective glasses had become available. He had also urged that the comfort of the operator should be studied by supplying goggles, helmets, and hand shields of correct shape and fitting.

(11) *Suggestions for Necessary Developments and Future Research.*—From the various experiences and discussions contained in the papers there emerged certain suggestions for future development and research. They included:—

(1) The development of electric welding plant in which the current would be automatically adjusted to suit the rate and quantity of deposit, combined with arc control; it was suggested by Adam that a high degree of reliability in welding would result.

(2) Extensive investigations should be carried out into the factors affecting the fatigue resistance of all types of welded joints in comparison with the equivalent solid, bolted, or riveted construction (Roberts).

(3) Investigations into the effect on fatigue strength of (*a*) peening, (*b*) heat treatment applied for stress relief, (*c*) deposits made with bare and coated electrodes, using both alternating and direct currents, (*d*) results of different welding techniques, (*e*) composition of electrodes and parent materials (Roberts).

(4) Development of forms of welded connections for dynamically loaded structures, especially bridges, on a basis of results of fatigue tests (Bondy).

(5) Investigations aimed at the more efficient welding of high-carbon and alloy steels (Ros and Eichinger).

(6) Extensive research into non-destructive methods of testing welding joints.

Discussion.

Mr. J. L. Adam, referring to the reference by Dr. Dorey to welding engine seatings, and the three advantages given for welded entablatures, added that the wheel base of an engine could be enlarged without any great increase in weight, as would be the case with a casting, and without any weakening of the structure.

With regard to Dr. Dorey's recommendation to manufacturers of pressure vessels that they should make samples of their joints, Mr. Adam went further and urged that it should become an established practice, as was the endeavour in shipbuilding, to make such samples, not so much to ascertain the strength of the joints as to ascertain the procedure by which the joints were made and to ensure uniformity in succeeding welding. He agreed with Dr. Dorey that of all forms of welded joint the butt weld was the most effective. As to dividing pressure vessels into classes, any pressure vessel in regard to which accident would endanger human life should be considered as being in Class 1.

Emphasising the point that manufacturers should take inspectors into their confidence in regard to experiments, and the possibility that manufacturers might fear betrayal of their secrets, he said that any classification man who betrayed the secrets of one manufacturer to another would not remain very long in his job, nor would his society remain very long in the confidence of his clients. If the manufacturer did not take the inspector into his confidence, how could he expect that surveyor to take his word for something, even though the manufacturer was quite satisfied that it was all right? Mr. Adam did not emphasise testing itself so much as procedure and inspection. Perhaps X-ray examination should be part of the procedure, because all reasonable precautions were necessary; but he suggested that ultimately efficiency depended on inspection and procedure, and especially on procedure and mutual confidence.

Although some of the authors of papers had pointed out the dangers of heat treatment, all were agreed that some form of heat treatment for pressure vessels was necessary. He had some doubt of the practical value of the impact and fatigue tests as at present carried out in their relation to welding or welded joints, but he believed that before very long some form of alternating test, on a practical scale, would be evolved. If pressure vessels were to be hammer tested, Mr. Adam considered that the hammer should be muffled.

Mr. O. Bondy (London) intimated that the results of endeavours to develop an abbreviated type of fatigue test for practical workshop purposes were rather satisfactory. The main result should be to give confidence to workshop people, and especially to the designer, in developing new designs of welded joints. Mr. Bondy also suggested that some international standardising of welding symbols could be arrived at.

Dr. G. A. Hankins (National Physical Laboratory), dealing with fluctuating stresses and their effect on design, said that what was wanted in the first place, as a rough general guide, was a comparison under fluctuating loads of riveted and welded connections. By such a comparison we might obtain a basis for design purposes so that we could utilise the basic stresses of riveted design to a certain extent in welded design. It was rather amazing that there was very little in the papers presented concerning the strength of riveted connections under fluctuating or pulsating stresses. Professor B. P. Haigh had made the general statement that none of the riveted connections he had tested under pulsating load had withstood such ranges of stress as were carried with safety by ordinary butt welds of plates of the same cross sectional area. On the other hand, it was quite clear that Messrs. Ros and Eichinger considered that a butt welded joint had only about two-thirds the strength of a similar riveted joint. Again, the results obtained by Professor Graf showed clearly that the riveted joint was better under fluctuating loads than the welded joint. The importance of that was that the existing British Standard Specification for steel structures made no allowance for fluctuating loads; yet in the German, the Austrian, and the Swiss Regulations there was definite allowance for fluctuating loads, so that in the case of a structure such as a crane runway, for example, subjected to heavy fluctuating loads, the working stress was considerably lower than in a structure subjected only to static load. Were we in this country suffering from a false sense of security in regard to pulsating loads on structures or were our Continental friends making unnecessary fuss about such loads?

It was stated by Dr. Dorey (the Chief Engineer-Surveyor of Lloyd's Register of Shipping) that pressure vessels should be designed on the basis of fluctuating loads; Mr. Pollard (H.M. Engineering Inspector of Factories), although he did not say so directly, had more or less inferred the same thing. Obviously, long and expensive experimental work would have to be carried out before we could design large pressure vessels on the basis of fluctuating loads. But there was the B.S.S. 487 for fusion welded air receivers, in which specification considerable emphasis was laid on the value of lacing straps placed across a welded butt joint, the straps being kept in position by fillet welds. But results were given in the papers which appeared to suggest that a lacing strap on a pressure vessel was a rather doubtful sort of strengthening for the butt weld. Dr. Hankins emphasised that because in the near future presumably we should be considering standard specifications for boiler and other pressure vessels of much heavier duty than the ordinary air receiver. If one specification provided for lacing straps, there would be a tendency for that particular type of design to be perpetuated. If lacing straps were not justified we should have no hesitation whatever in scrapping them.

Professor F. C. Lea (Chairman, Institution of Mechanical Engineers Welding Research Committee) suggested that before examination such as by X-rays could be of real value a good deal of research would have to be done to interpret the X-ray photographs, and the X-ray photograph test must be carefully related to some other types of test. He did not think the X-ray test could be related to the static tensile test. Similar difficulties would apply as to the degree to which the X-ray test confirmed or represented the bending and the impact test. We should be on much more certain ground if we could evolve satisfactory methods of subjecting materials to cycles of stress, and could obtain information as to the relationship of the degrees of imperfections as revealed by X-rays and the behaviour of the materials under cycles of stress.

Discussing the influence of cavities and inclusions, he said that in a fatigue bend test the surface condition was very important, because it was at the surface that the maximum stresses occurred; but in a test in the Haigh machine the internal inclusions, which seemed to have little or no importance in the bend test, became very important. He also emphasised the necessity for fairly large-scale experiments to obtain essential comparative data between riveted joints and welded joints.

Mr. N. H. Childs expressed the hope that when specifications were revised they would give manufacturers as much scope as possible to improve both their design and their methods of manufacture. A standard specification could be a standard of measurement, like the pound avoirdupois, or it could be a rigid regulation on a par with the rules of the inspecting societies. Those societies had a very definite duty to perform and they should have rigid rules; but that did not necessarily apply to a standard specification. In connection with small air receivers made in very large numbers prices were tight, and such things would not bear the cost of a rigid inspection procedure. From the manufacturer's point of view it would be very easy to organise regular tests of welders and methods of technique by which the joint efficiencies could safely be raised, and he was anxious that they should have scope for effecting improvements. He agreed with Mr. Simonis that tests were becoming too complicated and that the all-weld-metal test was not of the greatest value as a routine test. It was a scientific test.

With regard to the references to using riveted straps to strengthen the welded seam, he urged that the effect would be to weaken the seam; the rivet holes would weaken the parent plate and the strap would not strengthen the weld, because before it could carry a load it would have to move.

Professor E. G. Coker said he had found that the stress concentrations were less in the common form of butt joints than in others, and he had been glad to notice that that view was accepted by practical people who had to deal with joints in actual use.

Many people appeared to think that once the plastic stage was reached everything was equalised and nothing could go wrong, but Professor Coker did not believe that that was so. When examining models of joints in transparent material one could only interpret elastic effects; the plastic effects were there, but we did not know the laws with sufficient exactness to be able to say what the stresses were. Probably in the case of mild steel there was some ground for thinking that it did not really matter what the elastic effects

were, because at the plastic stage they disappeared; there was a redistribution of stress above the yield point which was extremely useful to the engineer. But in welded joints that stage might not be achieved. It must be borne in mind that we could not avoid stress concentration in any joint.

Mr. G. Ellson (Southern Railway) commented upon the reference to his experiments on girders, by Dr. Gough, who had indicated that so long as the work was under static conditions it might be all right, but if subjected to fatigue loads it might not be. Mr. Ellson pointed out that there was a vast amount of structural work subject only to static conditions; that being so, he suggested that the results he obtained in practical tests discussed in his paper would give a fair indication of what might be expected in ordinary structural work subject to static loads.

Mr. O. Simonis (London), referring to a paper in Group 2 by Mr. W. Spraragen (American Welding Society), who had talked openly of world co-operation in welding, remarked that that would be almost Utopian, because if the knowledge of all the world on welding could be co-ordinated we should be able to save an enormous amount of work. In America the universities had been pressed into service; they carried out research work, which was a subject for the universities far more than for the industrial interests, which had carried out all the research work in this country so far. That led Mr. Simonis to suggest that welding was entitled to a Chair at a British university, just as Chairs had been established in respect of other new industries, such as aeronautics. A great many firms had not weld-minded men in their design and drawing-offices, and that type of man had to come from the universities. Discussing Mr. J. O. Cooke's paper on the work of the British Standards Institution, he said that that body had done excellent work, and could do further excellent work, but not alone; we needed some body which would constitute a bottleneck through which the work on welding came out to the general public, and which checked up the work, so that there would not be confusion and duplication. One recent development in this country was that the Institution of Welding Engineers felt that it must make itself ready for bigger responsibilities, and had formed itself into the Institute of Welding.

Mr. A. B. Kinzel (Union Carbide and Carbon Research Laboratories, Inc., U.S.A.) referred to the very great advance which had been made during the last six or seven years in America, and said he believed a great deal of it was due to the fact that the insurance companies and the Codes had practically made procedure control mandatory. It was necessary to safeguard ourselves with regard to the strength of welds, and so on, by means of rigid tests. Later, when we had gained more experience we should be able to dispense with them. Many people X-rayed every inch of work as a routine practice, and X-ray photographs had become so standardised that there was no question in any given case as to whether or not the work would pass.

In welding a stainless steel pressure vessel, it was almost always necessary to cross a weld previously made. In so doing, one subjected the previously made weld to temperatures in the 500 deg. zone, and therefore it was important, in order to ensure maximum corrosion resistance, that the weld-deposited metal should be equally resistant with the steel to phenomena occurring within that temperature range.

Bronze welding was making very great headway in the United States. It was generally carried out very rapidly by the oxy-acetylene flame, and sometimes by the carbon arc, and there was greater probability of achieving successful results, approaching 100 per cent., than with any other types of welding. Bronze welding rods giving a strength of about 22 tons were available.

Mr. L. W. Schuster said he was in thorough agreement with the view that lacing straps gave a local stiffness which was highly undesirable in a welded boiler. The whole thing was a matter of weighing up the advantages and disadvantages. There were rules that no welds in tension must be rated at more than 50 per cent., which gave a measure of the trust that was placed in welding a few years ago. But welding had been improving, and the modern feeling was that welding could be rated at a higher figure. If we had such confidence in our welding that we could rate it at 90 per cent., it was of no use adding a cover strap, which would do harm. In the old days some drums were made in backyards, and we did not know the conditions under which they were welded, so that we could not give them a very high rating. But when welding a boiler under the very best conditions, knowing exactly the electrode used and employing skilled workpeople, the welding being supervised at every stage, the drums could be rated considerably higher. Similarly, in the old days there was heavy reinforcement on either side of the weld; indeed, it was fairly plastered on. But he held that where a weld was made under good conditions there should be no reinforcement whatsoever, and both surfaces of the weld should be dead flush.

He criticised Dr. Dorey's statement that there were two schools of thought with regard to the bend test, and asked the meeting to say that there was only one school of thought. He felt that they had not really found out what each was talking about, and it was necessary to thrash it out so that they might guide the B.S.I. Committee which was standardising the matter.

Although it had been stated by Dr. Hatfield that it was impossible to heat-treat bulky parts, he asserted that in many cases heat treatment was essential for the reduction of internal stress.

Dr. S. F. Dorey (Lloyd's Register of Shipping) emphasised the importance of the results of the fatigue tests given in the papers. They gave a feeling of satisfaction that we were beginning to know more about the homogeneity of deposited material, where used in vessels or other structures subjected to fluctuating stresses. Graf, Roberts, and Bondy had all satisfied us, he believed, perhaps without the necessity for any more elaborate tests being carried out, that the cover plates were unnecessary. But he suggested that none of the authors had given all the information necessary concerning the material and the heat treatment of fatigue test specimens. Material might be worked differently by different manufacturers. Again, the results of fatigue tests on one thickness of plate did not necessarily apply to fatigue tests on other thicknesses. It was the practice of one steel works to normalise all boiler plates of certain thicknesses, but not others. Not only was it necessary to qualify the heat treatment, but to say how it was applied, so that when small specimens were cooled we might know that the structure was such as would be obtained when cooling large bodies.

The results of Professor Haigh on alternating fatigue tests suggested that a reasonable figure for such a test was $\pm 5 \cdot 5$ tons per square inch. But Dr. Dorey suggested that for pressure vessels a figure of ± 9 tons per square inch might be considered satisfactory. It was helpful that Dr. Hankins had given a range of something like 13 tons, the minimum stress being zero. Those were very satisfactory results, indeed. Dr. Dorey had made tests on deposited metal and had obtained fatigue test results of ± 11 tons per square inch for a number of reversals of about 5 millions. Fatigue tests on boiler drums were representative tests, and he suggested that one million reversals should be quite satisfactory.

In regard to X-ray tests on metals, he suggested that the proper taking of the photographs was even more important than the interpretation of them. It was extremely difficult to find a crack by X-ray examination. But one could see the cavities, and also the shapes of the cavities, which might lead one to believe that a vessel would fail under alternating stress more quickly than if the cavities were of different shape.

He did not think that the tests included in Lloyd's Register tentative specification were in any way too severe, particularly with regard to Class 1 pressure vessels. Perhaps the classing of the vessels was not quite clear. His own feelings was that an air receiver might not necessarily be a Class 1 pressure vessel; a vessel for containing ammonia or obnoxious gases might not need to be in Class 1. For air receivers he would suggest that all that was required was a tensile test, a bend test, and a nick test.

Referring to test plates attached to the end of the shell, by which the strength of the seam itself could be tested, he said that the plates were of the same thickness and quality as the shell of the drum, and, given good-class workmanship, he believed they gave all the information necessary. He did not consider the operator would carry out those particular welds very much better than he would the seams in the actual shell. In emphasising that high-class work should be left only in the hands of people who could do high-class work, he said that some people, having made small air receivers, considered that they could produce any pressure vessel; but some of the small air vessels he had seen were such that if they were passed, and if anything unusual happened, the result would be to hold back the development of really high-class work.

Mr. R. A. Stephen pointed out that in order to know more about internal stresses we should know the changes which had occurred in the metal independently of the welding process; he had in mind rolling stresses, and so on, which might be in the opposite direction, so that the stresses would cancel each other out. He supported the X-ray method of testing.

Sir Harold Carpenter, President of the Organising Committee, in winding up the Symposium, said it was the view of the Organising Committee that it had been a magnificent success. He expressed thanks to all who had been concerned with the organisation, particularly to Dr. Gough (Vice-President of the Organising Committee), whose wonderful knowledge and enthusiasm for every branch of the subject had rendered it possible to collect together the great series of papers presented. Thanks were also expressed to Mr. Headlam-Morley (Secretary, Iron and Steel Institute) and Mr. A. E. Chattin (Assistant Secretary) for their work in the organisation of the Symposium; to Dr. J. E. Holstrom, for having acted as interpreter; and to the Institution of Civil Engineers, in whose building the meetings were held.

The British Industries Fair at Birmingham.

No. V.

(Concluded from page 590, June 7th.)

Coventry Climax Engines, Ltd.

FROM the range of engines shown by Coventry Climax Engines, Ltd., of Friar's-road, Coventry, we have chosen for illustration the new B4 type four-cylinder, four-stroke, 4¼in. bore, 5½in. stroke engine, which, while following the firm's standard production, was shown at Birmingham arranged for working on producer gas by means of the system of High Speed Gas (Great Britain), Ltd., which firm was jointly interested in the exhibit. The engine illustrated is interesting as providing a possible new outlet for home-produced fuels. Other engines shown on the stand included a P type four-cylinder four-stroke unit with 90 mm. bore and 130 mm. stroke, which has been specially designed for compressor driving, pumping, and similar duties. A smaller engine of G.S.M. type was shown with a 56 mm. bore and a stroke of 86 mm., which is adapted for driving arc welding sets and small electric generating plants. A feature of all the engines shown is the neat grouping of the engine control levers, as shown in the illustration Fig. 51.

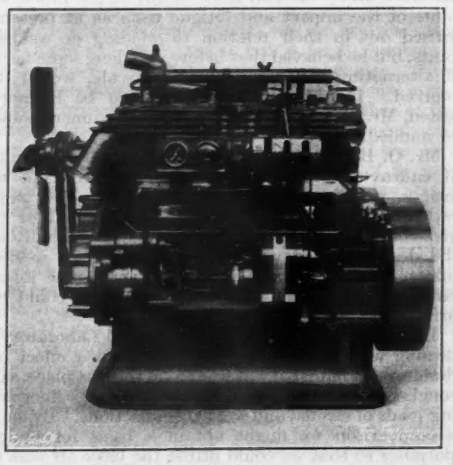


FIG. 51—FOUR-CYLINDER ENGINE—CLIMAX

Hunt and Mitton, Ltd.

Hunt and Mitton, Ltd., of Oozells-street, Birmingham, exhibited valves of all types suitable for pressures up to 450 lb. per square inch and temperatures up to 800 deg. Fah. Among these was the packless valve, in which the valve itself is of truncated cone shape. The pressure side is above and the outlet below. Thus, when closing the valve, no danger of it jamming need be feared, as the pressure is equalised and, once closed, the supply pressure tends to keep it down on its seating. A diaphragm seals the spindle and protects the thread from the fluid or gas passing. Another model is the Everlasting valve. In this a disc is given a partial rotary motion, which places it across the path through the valve. The advantages claimed for this valve are a straight-through passage of full pipe bore and quick opening and closing simply by the movement of a lever through about 70 deg. In addition, the valve requires no grinding and has no packing and is thus claimed to be everlasting. The "Easyturn" valve was also shown. It is an inverted plug cock, the plug being spring loaded. Pressure on the handle will take all load off the barrel as it unseats itself. This valve is thus always easy to turn and is saved the scoring and wear of being forced round when "home" on its seating.

Villiers Engineering Company, Ltd.

A wide range of petrol engines, free wheels, and two-speed gears was shown by the Villiers Engineering Company, Ltd., of Wolverhampton. It may be recalled that in our issue of November 9th, 1934, we gave a full description of the company's Marston Road Works, and described many of the engines shown at this year's Fair. A new engine, however, is one designed to develop a maximum output of 12 b.h.p. at 5000 r.p.m. It is a two-stroke model, and is illustrated in Fig. 52 herewith. The principal feature of this new unit, which was only put on the market early this year, is the use of a flat-topped piston in conjunction with a new system of scavenge and exhaust ports. The design in general

follows Villiers' accepted practice, and the capacity of the cylinder is 249 c.cm., with a bore of 63 mm., and stroke of 80 mm. The arrangement of ports may perhaps be appropriately likened to two pairs of acetylene gas jets, which, by the impinging of the two streams of entering air, form an upward rising column. The two jets meet above the exhaust ports and spreading upwards and outwards drive out the burned charge, which passes away through the two exhaust ports in the lower part of the cylinder. The arrangement of the air and mixture transfer ports is such that a cool piston is maintained with, it is claimed, a good lubrication and a high operating

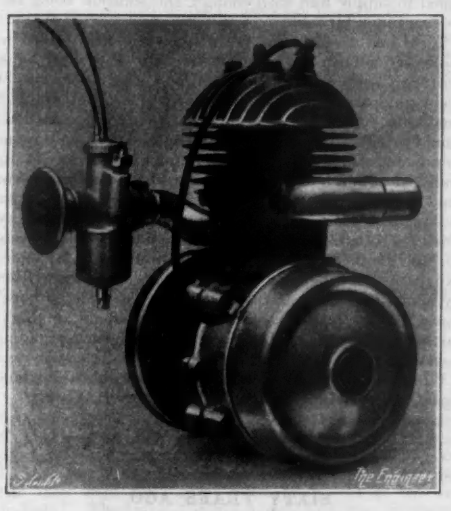


FIG. 52—12 B.H.P. PETROL ENGINE—VILLIERS

efficiency. In addition to the engine above referred to, a series of two-stroke engines, both water and air cooled, was exhibited, along with several examples of small petrol-fired portable cooking and heating equipments in which the firm specialises.

FLEXTOL ENGINEERING COMPANY, LTD.

Flextol Engineering Company, Ltd., of 149, Lupus-street, London, S.W.1, was exhibiting a range of its flexible shaft-operated tools. We illustrate the mechanism of one of the firm's hand pieces in Fig. 53.

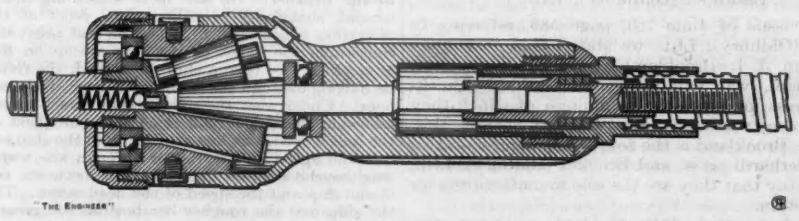


FIG. 53—HANDPIECE OF FLEXIBLE DRIVE TOOL—FLEXTOL

It consists of a combined clutch and variable speed gear. The mechanism operates on the sun and planet principle, conical rollers being used as sun member and planets. Owing to their shape, a variation of ratio occurs as the planet rollers are pushed further up the sun roller by the pressure applied to the tool.

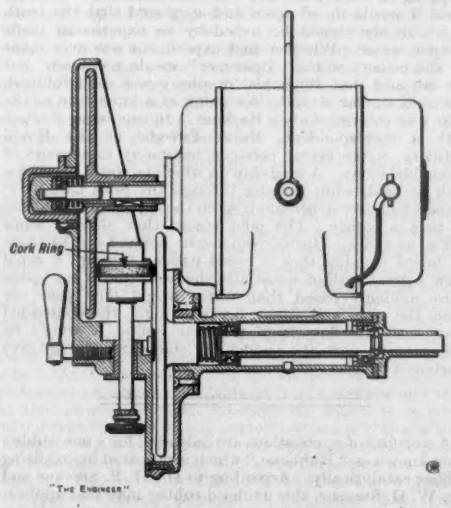


FIG. 54—VARIABLE SPEED GEAR—FLEXTOL

When pressure is removed the rollers cease to be in contact and the tool stops. A second hand piece contains a multiplate clutch operated by a thumb lever. This model is used for high-speed work such as grinding, burnishing, drilling, and milling, special cutters being supplied. A percussion hammer is also included in the range operated by cams. This device is claimed to be unique in its design. Lastly, the firm showed a friction type variable-speed gear fitted to a motor mounted on gimbals to drive a rotary file and grinders through a flexible shaft. This gear has a compound reduction and compound variation of ratio, since the speed adjusting screw operates by moving a small wheel across the faces of two friction wheels, thus reducing the relative diameter of the driving wheel and, at the same time, increasing that of the driven wheel, as shown in Fig. 54. Speed can be varied from maximum to about one-tenth of maximum by this means.

PERRY AND CO., LTD.

An interesting demonstration of the use of chain drives in industry was presented on the stand of Perry and Co., Ltd., of Tyseley, Birmingham. Roller chains of all sizes up to ¾in. pitch were shown in single, duplex and triplex types. Various drives were on view, running at speeds from 710 to 9·9 r.p.m. In addition, two conveyors of the chain type were running. One of these was of the hook type and was picking up parcels and holding them during their travel, irrespective of the angle of ascent of the conveyor. The space occupied by the conveyor was commendably small. In addition, a section of a slat type conveyor chain was shown running. It was interesting to note the silence attained on the stand, in spite of the numerous drives in operation.

GEORGE H. ALEXANDER MACHINERY, LTD.

Two interesting testing machines were shown on the stand of George H. Alexander Machinery, Ltd., of 82, Coleshill-street, Birmingham. They were both hardness testers, but of very different purposes. The first was the Erichsen pattern sheet metal tester, and it includes a deep-drawing device. The machine works on a combination of the Brinell principle and the deep-drawing principle. The design of the machine is practical to make it suitable for use in shops. The dynamometer measuring device gives a fixed reading showing the maximum pressure applied as the pointer does not return when rupture occurs. This enables the operator to read at his leisure and obviates missed readings. The "deep-drawing" test, which consists of widening the Brinell impression until tearing occurs, is applied by means of dies, sets of which can be supplied either to Erichsen standards or to those of Professors Siebel and Pomp, of the Kaiser-Wilhelm Institute for Iron Research. An interesting rotating centring device to ensure that the depression occurs centrally on the test piece is fitted. The machine can also be supplied to perform tensile tests on wire or sheet metal up to 3 tons load, and for Brinell tests with 5 mm. and 10 mm. balls. The second machine was the Rockwell hardness tester. It consists of a press, which forms an impression in a similar manner to the Brinell test. The difference, however, lies in the fact that the hardness of the test piece is based on the difference of penetration due to two different applied loads, the first being about one-tenth of the second. Either a $\frac{1}{16}$in. steel ball or a sphero-conical diamond "Brale" test point of 120 deg. angle is used, according to the hardness of the metal on test. The latter is a patented penetrator in which the diamond point is actually spherical of 0·2 mm. radius. An advantage of this point is that the impression is too small to mar the appearance of the piece tested. Ease of operation combined with accuracy is ensured with this machine by the fact that the actual load applied is fixed by leverage and weights, and is independent of the operator. Both penetrations are shown on the dial, and remain registered until the operator returns the pointers to zero. Various anvils for specially shaped parts are supplied, as well as different brackets and a jack for large parts. An interesting device is called the "eyeball" anvil, and consists of a hard steel ball ground flat on one face and held in a chuck fitting the tester's elevating screw. Any desired angle of the flat face can be obtained and the ball clamped in position.

R. H. NEAL AND CO., LTD.

On the stand of R. H. Neal and Co., Ltd., of Plant House, Ealing, W.5, was to be seen a practical example of the contractor's crane, Fig. 55. It is built on a steering chassis suitable for towing behind a lorry and for travelling packed into a compact and well-balanced assembly not likely to interfere with the manœuvring of the towing lorry. On the site the mast could be extended and the crane prepared for work in the minimum of time. On the latest model a petrol engine drives the hoist and slews the crane. The jib is manœuvred by hand. An interesting point is the fact that hoisting is operated through belt drive, a fast and loose pulley being incorporated. This forms a useful safety measure when the crane is operated by an unskilled man, as a false movement merely slips the belt and will not stall the engine or cause other damage. In addition, declutching the engine leaves the winding drum held by the brake, so that safety has been carefully studied. A useful hoist for builders was also shown. It operates by a geared winch and is automatically locked when the tension is released on the hoist. A small model of

FIG. 55—CONTRACTOR'S CRANE—NEAL

the "Injecto" pump was shown. This pump is of the diaphragm type and is capable of dealing with dirty water without trouble.

GEORGE SALTER AND CO., LTD.

George Salter and Co., Ltd., West Bromwich, were exhibiting the Salter safe load indicator for cranes—Fig. 56. This machine has a two-fold application, in that it can either be suspended from the trolley, and thus give the driver a continuous reading showing each load as he lifts it or it can be attached to a small portion of the runway which is made independent of the rest. When the trolley runs on to this portion the load can be read. This method has the advantage that the lift of the crane is not reduced by

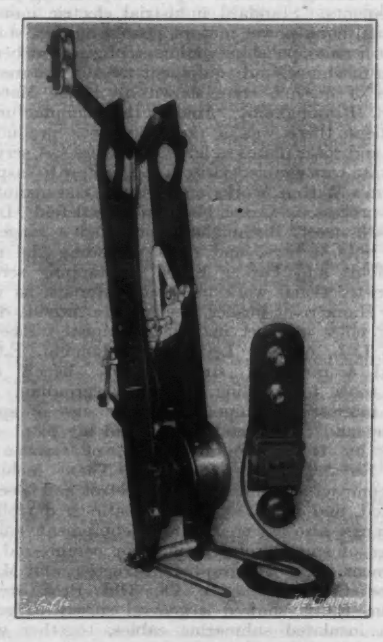


FIG. 56—CRANE SAFE LOAD INDICATOR—SALTER

the length of the weighing machine, a great advantage where height is a consideration. Other applications of the spring balance principle were also shown, including a range of weighing machines with capacities from a few grains to 100 tons, a practical attachment of interest being a means of reading the number of identical articles at the same time as the weight. Thus when screws or small parts are checked by weighing, the number of grosses, hundreds, or dozens, as required, is read off as well as the weight on the pan. Also interesting was the sand compression tester used for testing the strength of sand cores. We learn that this was the latest design to be approved

by the British Cast Iron Research Association, a useful feature being the maximum pressure pointer fitted.

JAMES NEILL AND CO. (SHEFFIELD), LTD.

James Neill and Co. (Sheffield), Ltd., of Napier-street, Sheffield, were exhibiting an interesting magnetic chuck. This works entirely by means of permanent magnets, thus obviating the use of electricity and its attendant wires, rectifiers, or generators. It thus becomes fully portable and can be moved about the works from one machine to another. Moreover, a supply failure does not mean that the work will shift on the machine and require resetting up or, worse, cause a "false cut" to be made. Naturally, the magnets are carefully protected from loss of magnetism by the keeper system brought into use when the lever corresponding to the switch is moved. In addition, the alloy used is the same as that used in electricity meters and other instruments which depend for their accuracy on the constant field of permanent magnets. We understand that the strength of the pull exerted in a 14in. by 6in. chuck is nearly half a ton. A range of magnetic chuck blocks and demagnetisers was also shown, together with a range of other products of the firm.

OTHER EXHIBITS.

The Brooke Tool Manufacturing Company, Ltd., of Birmingham, exhibited a comprehensive range of cutting tools of various types. It also showed a range of pumps from lubricant supply pumps for machine tools to high-pressure pumps suitable for various hydraulically operated devices. High-Speed Steel Alloys, Ltd., of Widnes, provided an exhibit covering their products used in the manufacture of alloy steel and iron. These included a range of metallic alloys, pure metals, and salts and oxides. Langley London, Ltd., of 161, Borough High-street, London, exhibited its well-known range of "Stelcon" anchor steel plates. Tecalemit, Ltd., of Great West-road, Brentford, showed a complete range of lubrication fittings of all types. These included the new compressor units for for garage and workshop use, all of which are now twin-cylinder units. In addition, the Pneugrippa machine for regrooving motor car tires was shown. The Birmingham Battery and Metal Company exhibited a range of non-ferrous products, chiefly copper, of great interest. The exhibits of S. Wolf and Co., Ltd., of 115, Southwark-street, Blackfriars Bridge, S.E.1, included a complete range of portable electric drilling machines from $\frac{1}{2}$in. to 1in. capacity, bench drill stands, bench and pedestal tool grinding machines, and portable and lathe grinders. Other useful tools were portable electric blowers, screw drivers, nut setters, and hammers, "Wolf" flexible shaft, grinding, filing, and polishing machines, and garage and engine kits. A new product exhibited was the "Wolf Cub," which is a light-duty, $\frac{1}{4}$in. electric drilling machine, capable of meeting many requirements. Standard industrial electric motors, fractional horse-power motors, geared motors, stator and rotor units, polishing motors, tool grinders, bench drilling machines, and equipment used in the manufacture of motors, were shown by Higgs Motors, Witton, Birmingham. Among the manufacturing equipment there was a notching press producing stator and rotor plates in large quantities. A service of private cars enabled visitors to the Fair to inspect the firm's Witton Works and witness the manufacturing processes. Guest, Keen and Nettlefolds, Ltd., of Heath-street, Birmingham, provided a range of bolts, nuts, screws, and nails, including the new Nettlefolds and Parker Kalon self-tapping screws for constructional work in sheet materials, as well as the Hank rivet bushes, designed to provide deep tapped holes in sheet material. Grimston Electric Tools, Ltd., of 138, Lever-street, London, E.C.1, showed a range of small electric bench and hand tools for drilling, polishing, grinding, &c. Some interesting equipment for the use of spray painters and for general compressed air plant was shown by B.E.N. Patents, Ltd., of Gorst-road, Park Royal, London, N.W.10. These included very compact compressor units, petrol and electric operated, and mounted on pneumatic-tired trollies. The range also covered garage equipment and a number of small useful fittings for compressed air equipment. The Telegraph Construction and Maintenance Company, Ltd., 38, Old Broad-street, London, E.C.2, showed a general survey of gutta percha insulated submarine cables, together with various types of conductors and accessories.

Road construction and building machinery and various mixers for concrete, plaster, mortar, &c., were exhibited by Frederick Parker, Ltd., of Catherine-street, Leicester, while William Bunce and Son, of Ashbury, Swindon, showed road gritting machines and a snow plough attachment for use on the front dumb irons of a lorry. British Bound Brook Bearing Company, of Birch-road, Witton, Birmingham, was exhibiting the "Compo" oil-retaining bearing made of porous bronze, as well as a phosphor-bronze graphited bearing. W. Canning and Co., Ltd., of 133, Great Hampton-street, provided on their stand for inspection an automatic chrome plating plant and two of their new polishing machines. Various plating machines of different types were also shown and a series of polishers for special work were on view. D. Moseley and Sons, Ltd., showed a large range of rubber products, such as hosing, packings, and roller coverings.

The Midland Fan Company, Ltd., of 212, Aston-road, Birmingham, exhibited a practical series of spray-painting installations, suitable for all types of painting, together with extraction and ventilating fans. The Canadian Government Exhibition Commission showed a range of articles imported from Canada. The Norwich Union Insurance Society stand was unusual in being built to represent boilers. Some unusual tools were exhibited by Sanderson Bros. and Newbould, Ltd. Frederick Braby and Co., Ltd., of Fitzroy Works, Euston-road, N.W.1, exhibited an interesting conveyor among other metal products for building purposes. Various types of breathing apparatus and helmets for welders, &c., were shown by Siebe, Gorman and Co., Ltd., of 187, Westminster Bridge-road, London. R. and J. Dick, Ltd., exhibited a range of belting and allied products. Steels of various types were on view at the stand of British Rolling Mills, Ltd., of Tipton. Turner Bros., Ltd., of Birmingham, demonstrated the rapidity of their production methods. Wellworthy, Ltd., of 89, Blackfriars-road, S.E.1, showed the "Welflex" piston and "Thermocrom" piston rings for automobile engines. Stewarts and Lloyds, Ltd., of Westminster, London, S.W.1, exhibited an interesting line of fittings and joints, both welded and flanged, for steam and other high-pressure installations. A range of drop forgings, both stock and special types, were shown by Carron Company, of Falkirk. Plumbago mined in Ceylon was on view at the stand of British Foundry Units, Ltd., of Retort Works, Chesterfield. Thos. Firth and John Brown, Ltd., had a pleasing exhibit of stainless steel products. Woven Wire Cloth for use in filters was shown on the stand of G. A. Harvey and Co. (London), Ltd. Tubing in all types was on view at Accles and Pollock, Ltd., stand. Charles Taylor (Birmingham), Ltd., showed a large variety of chucks, vices, bending machines, &c. Wire rope from billet to coil was to be seen on the stand of the Whitecross Company, Ltd., Warrington. The Equipment and Engineering Company, Ltd., of 2, Norfolk-street, Strand, W.C.2, demonstrated their patent electro-magnetic crack detector for use on forgings or castings. Various packings for every type of joint, including the well-known Lion packing, were shown by James Walker and Co., Ltd., of Woking, Surrey.

BROOKES (OLDBURY), LTD.

In our issue of June 7th, page 589, referring to Brookes (Oldbury), Ltd., we stated that "an associated firm, J. L. Brookland, of 20, Waterloo-street, Birmingham, was exhibiting the Gerhardi Quick-Action press for synthetic mouldings, of which they are the constructors." We wish to correct this. Mr. J. L. Brookland is the sole selling representative for the Gerhardi press, and Brookes (Oldbury), Ltd., ask us to say that they are the sole manufacturers for Great Britain.

In our description of the two-high reversing strip mill, we would also add that the motion is reversed by a tramway type controller, which also operates a magnetic brake. The drive is through a clutch to the coiler drive, a slipping clutch being incorporated in the second coiler drive.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

SKILLED LABOUR.

SIR,—I was greatly interested in Mr. Holloway's letter concerning skilled labour. As far as war-time trained munition workers are concerned we are quite well aware that they had to be taught and controlled by "key" men, and that they could not be regarded as skilled in the sense in which that term is applied to the engineering industry.

My sole object in referring to them was merely to give an example of adaptation. I think Mr. Holloway will concede that the majority of them did very well in what, to them, were very unusual circumstances. That, however, is a minor issue. The main point of my previous letter was that skilled craftsmen who had been engaged in other branches of engineering could be adapted to those in which there is a shortage, such as that mentioned by your correspondent—toolmaking.

During the years of depression many fine craftsmen have been obliged to take up work such as, say, plant maintenance, not because they were interested in it, but because opportunities in more congenial fields were practically non-existent. Others have been forced out of the industry for similar reasons. Now that there are signs of a revival, alarm is being expressed that there is a shortage of specialists in certain branches.

As far as toolmaking is concerned, one of the largest toolmaking firms recently advertised for mechanics. The writer, although not strictly speaking a toolmaker in the specialist sense, but with experience in the repair and reconditioning of machine tools, answered the advertisement, and was informed that the vacancies had been filled!

In conclusion, I would like to repeat that the skilled labour shortage is one capable of solution. Much more momentous problems than this have been solved before and will be again. J. ELLIOTT.

Newcastle-on-Tyne, June 8th.

SOCIAL CREDIT.

SIR,—"New Briton's" answers amount to little more than this: that (1) the consumer is short of purchasing power; (2) because someone (the "money power") has failed to supply him with enough, the solution being (3), to give him a bit more.

It is just twenty-five years since my first letter on monetary reform was published. For a quarter of a century I have read and thought, and sought solutions of social, industrial, and financial problems; but am still unable to supply the clear-cut (short-cut) proposals that would satisfy "New Briton." I can, however, endeavour to prevent others from following what I believe to be false trails. I can also strongly recommend "New Briton" to read (if he has not already done so) "Wealth and Life," by J. A. Hobson, and chapters XX to XXVI of "Profits," by Foster and Catchings. Whilst not binding myself entirely to the views of these writers, I find them far more exhaustive and logically satisfying than anything written by Major Douglas. At the risk of being considered hopelessly remote from practical everyday affairs, I would further recommend a close study of a much earlier volume containing a variety of remarks on profits, such as: "What shall it profit a man, if he shall gain the whole world, and lose his own soul?" HUGH P. VOWLES.

London, June 11th.

SIXTY YEARS AGO.

ON the trial trip on May 8th 1875 of the steamship "Bessemer" an accident occurred as the vessel was about to enter Calais Harbour. Our representative on board gave in our issue of May 14th what would appear to be a satisfactory explanation of the mishap. Under good way in the open sea, he reported, the ship answered her helm with readiness. She was however of much greater length than the vessels which ordinarily entered Calais and as soon as a portion of her hull was under the shelter of the west pier the current and the breeze swung her stern round. She refused to answer her helm and, striking the jetty, demolished about 50 yards of it. In our issue of June 4th Professor Osborne Reynolds went more deeply into the cause of the accident. He refused to accept the common statement that it was attributable to the weather. He saw in it something more fundamental, something providing clear proof of the truth of certain conclusions to which he had previously come concerning the effect of stopping a ship on her power of steering. To turn a ship, he argued, the rudder must be moving through the water in its immediate neighbourhood. Under way, the rudder worked in the dead water following the ship. This dead water dragged along by the hull moved with less velocity than the ship and therefore the speed of the rudder through the water in its neighbourhood was the difference between the speed of the ship and the speed of the dead water. The longer the ship and the rougher her bottom the greater would be the speed of the dead water and the slower would be the speed of the rudder through the adjacent water. When the vessel was stopping the rate of retardation of her speed might readily exceed that of the dead water with the result that the relative speed of the rudder might fall towards zero. The diminution or disappearance of the steering force brought about in this manner, Reynolds argued, would be assisted by the reversal of the propellers or paddle wheels, the effect of which was to increase the speed of the dead water. He prophesied that if the stopping of the "Bessemer" interfered with her steering once, it would do so again and suggested that the truth of his theory should be tested by an experiment made in open water. Whether that experiment was ever made by the owners of the "Bessemer" we do not know, but we can add that Reynolds' prophecy was soon fulfilled, a second similar accident occurring at a later date as the ship was entering Calais Harbour. In our issue of June 11th a correspondent, Major Tweedie of the Royal Artillery, wrote giving personal testimony in support of Reynolds' views. A long ship on which he was a passenger had, he said, while passing through the Suez Canal run aground on several occasions when the speed was slackened to turn a corner. The pilot stated that all long ships did so at times. Our correspondent pointed out to those on board his ship that a vessel passing through a canal drew a great rush of water after her and that if her speed were suddenly eased that water would flow past her from the rear and upset her steering. He contended that until the flow from the rear ceased it would be necessary to port the rudder for starboard and to give starboard for port.

A NUMBER of applications are indicated for a new rubber resin known as "Rubbone," which is prepared by oxidising rubber catalytically. According to Dr. H. P. Stevens and Mr. W. H. Stevens, this oxidised rubber may find application as a constituent of paints, varnishes, and enamels, for electrical insulation, particularly in the impregnation of coils, and the like. The material is capable of further oxidation (drying) and of thermosetting. Owing to its fluidity at raised temperatures, "Rubbone" is stated to be especially valuable for impregnating electric wire coils, since no solvent or other impregnating medium is required. On baking the impregnated coil the solid mass of the "Rubbone" thermosets to an elastic insulator, and the surface case-hardens by oxidation. In this condition the material is substantially water and oil resistant.

Rail and Road.

IT is officially announced that Mr. E. E. Painter has been promoted to the position of secretary to the Railway Clearing House, in succession to Mr. P. H. Price, who died at Easter whilst on a sea cruise.

WHILST Minister of Labour, Mr. Oliver Stanley, continuing the series of meetings which he was having with representatives of individual industries on the subject of the possibilities of the absorption of more workers into employment, recently met representatives of the main line railway companies. There was a full discussion and the representatives of the companies agreed to examine the position and to keep in touch with the Department.

INCLUDING in the information conveyed by the Minister of Transport in his statement of June 3rd on the Vote for his Department, was the announcement that it was hoped within five years to eliminate all those weak bridges in the possession of railway and other statutory owners, which most seriously affected the free flow of traffic. There were 1068 such bridges, and of these, 226, or practically 20 per cent., would be put in hand during the current financial year.

THE Ministry of Transport railway statistics for February have now been issued. They show that, compared with the corresponding period of 1934, there was an increase of 3 per cent. in the number of passenger journeys and of 1 per cent. in the receipts from passengers. There was, however, a decrease of 1·5 per cent. in the tonnage of freight carried, and of 2·2 per cent. in the receipts from freight traffic. There was little change in the freight-train mileage, and the average train load decreased from 130¾ to 127½ tons, but the net ton-miles per engine-hour rose from 458½ to 464¼.

SPEAKING recently at the opening of new offices for the Channel Islands Airways at Victoria Station, Sir Herbert Walker, general manager of the Southern Railway, said that last year 16,000 people travelled by air to the Isle of Wight. Mr. J. B. Elliot, assistant traffic manager, said that they were determined "not to be out of the air business." They would spend money and were prepared to lose money for a time in order to give the country a chance of supporting internal air services. The present policy of the railways was not to run a route in competition with fast, frequent main line services, but to link by air towns which were difficult of access by rail.

HEREIN, on February 8th, we referred in connection with the removal of the L.M.S. Crewe divisional engineer's staff to St. Pancras, to the probability of the Manchester and Derby divisional engineers and their staffs also being transferred. It is now officially announced that Mr. E. H. d'E. Darby, divisional engineer, Derby, becomes assistant engineer (permanent way), St. Pancras; Mr. S. O. Cotton, divisional engineer, Manchester, becomes assistant engineer (structures), St. Pancras; Mr. J. Briggs, district engineer, Bangor, becomes senior assistant (permanent way), St. Pancras, to be succeeded at Bangor by Mr. R. C. Irving, from Abergavenny; and Mr. R. L. McIlmoyle, engineer, Belfast, becomes senior assistant (structures), St. Pancras. Mr. N. L. Wallis succeeds Mr. Irving at Abergavenny.

THE collision, thirty-five years ago on June 16th, at Slough, Great Western Railway, in which the 1.15 p.m. express from Paddington to Falmouth ran into a standing passenger train and five passengers were killed, filled the public, reported Sir Arthur Yorke to the Board of Trade, "with bewilderment and consternation which were, not altogether unnaturally, followed by feelings of indignation. It seemed hardly credible and quite inexplicable that in broad daylight on one of the principal lines in the kingdom, which is equipped with the most modern appliances for the purpose of ensuring safety, it should be possible for an express train to overtake and run into another train standing in an important station under cover of the signals." No explanation could be found for the driver failing to observe the signals that were against him. He may have been drowsy without being aware of the fact or his attention may unwittingly have wandered from his duty and so produced the condition familiarly known as "absence of mind." The man was in his sixtieth year, but had all the appearance of a man ten years older. When he reached sixty in the following December, his retention in the service would have come up for consideration, but having regard to the exhausting nature of a driver's life and the unremitting vigilance demanded by his duties, Sir Arthur thought that these men should be examined by a medical man at the age of fifty-five and each succeeding year thereafter.

THE Vote for the Ministry of Transport was taken in the House of Commons on June 3rd, which gave Mr. Parkinson, the Member for Wigan, the opportunity of commenting on Mr. Hore-Belisha's statement in moving the Vote that there were 1385 level crossings on classified roads and his hope that the 75 per cent. grants available for highway authorities would accelerate their elimination. Mr. Parkinson thought that any Government ought to do all it possibly could to do away with those crossings, which were a danger and a menace to public safety. Incidentally, these remarks inspired *The Times* to preface them with the cross-heading "'Menace' of Level Crossings." As it was obvious that the Minister of Transport's statement referred to public road level crossings and not to the occupation level crossings—of which it is estimated that there are 10,000 or more—it is a pity that when Captain Hudson replied to the discussion he did not point out that figures show that public road crossings are not a danger. The report by Colonel Trench on the Wormley occupation crossing accident of November 27th last, which was reviewed in a leading article in our issue of February 15th, showed that there are 4567 public road crossings in this country, and that during the five-year period 1929–33 the average number of people killed each year at those crossings was thirteen, of whom only four were the occupants of road vehicles; the remainder were pedestrians or railway servants. All public road crossings, except those on Light Railways, are required by law to be provided with "good and efficient" gates to fence off the railway from the road, which are to be worked by "good and proper" persons.

Miscellanea.

THE new Dnieprovsk Aluminium Works in the U.S.S.R. have started production and it is expected that the output this year will be 17,000 tons.

ONE of the biggest quarry blasts ever made was recently fired at Bonawe, Argyllshire. Some 20 tons of explosive were used, and it is estimated that 750,000 tons of granite were brought down.

WHAT is believed to be the first factory of its kind in the world is to be erected in South Africa for the production of wrapping and writing paper from bagasse—the cane refuse from sugar mills.

WE regret to have to announce the death on Sunday, June 2nd, of Mr. E. C. Reed, for many years publicity manager to Edward Bennis and Co., Ltd., and Editor of the firm's house journal, *Cheap Steam*.

LAST year, 33,060,000 metric tons of coal were raised in Japan as compared with 32,520,000 tons in 1933. Pig iron output totalled 1,932,000 tons as against 1,596,000 tons in 1933, while steel output last year was 3,720,000 tons as against 3,048,000 tons in 1933.

AT the fifty-third annual general meeting of the Chartered Institute of Patent Agents, held on June 5th, Messrs. G. E. Folkes, M.I. Mech. E. (Birmingham), and R. J. Tugwood (London) were elected President and Vice-President respectively of the Institute.

H.R.H. THE DUKE OF GLOUCESTER, K.G., and the Right Hon. the Earl of Athlone, K.G. (Chancellor of the University of London), have accepted invitations to the annual dinner of the Institution of Mechanical Engineers, to be held at the Connaught Rooms, London, on Friday, October 18th next.

THE Minister of Transport recently said in the House of Commons that the canals had their best year in 1934 since the financial crisis in 1931, and conveyed 480,000 tons more traffic than in 1933. It should not be forgotten that about 12,000,000 tons of traffic pass annually by canal, nearly half being coal.

WE regret to learn of the death of Mr. E. L. Pope, who was for many years attached to the staff of the Chelsea Electric Supply Company, and served with Callenders Cable and Construction Company, Ltd., and the L.C.C. tramway undertaking. Mr. Pope, who was for forty years a member of the Institution of Electrical Engineers, died last week at his home at Holt, in Norfolk.

THE Postmaster-General announces that, after the temporary reductions in Empire radio-telephone rates, introduced as a Silver Jubilee concession during May, arrangements have now been made with the overseas authorities concerned for permanent reductions of the rates in the services to Australia, New Zealand, India, the Union of South Africa, and Northern and Southern Rhodesia. The reduced rates will take effect at once.

THE Ministry of Transport has under consideration a scheme for the provision of a bridge over the river Severn, and, according to *Machinery*, the Cardiff Corporation has decided to become associated with the project. The scheme would be of value in securing greater industrial co-operation between Bristol and Cardiff, and in this respect the engineering and contracting trades might be expected to benefit. The bridge would cost about £5,000,000, and there is little doubt that all the steel work could be obtained from the steel-producing centres of South Wales, especially as that would mean a considerable saving in transport costs.

THE first experimental factory to manufacture synthetic rubber from the by-products of oil refineries is to be started shortly in Moscow, says the *Chemical Trade Journal*. About 15 kilos. of high-quality rubber can, it has been shown by the preliminary investigations, be obtained from the by-products from the refinement of 1 ton of oil. With the present capacity of the oil industry, this should provide for 12,000 tons of synthetic rubber per annum. The plant in Moscow will produce 100 kilos. of artificial rubber per day. The experience gained in this plant will be used in the construction of several large plants for the production of synthetic rubber from petroleum by-products on a large scale.

A FIRM of American welding engineers has developed a new arc-welding electrode by the use of which the cutting edge of all kinds of machine tools can be restored. This electrode, known as "Toolweld," provides a deposit which is equivalent to high-grade tool steel, and it is claimed that the deposit is of such a nature that it retains its hardness up to a temperature of approximately 1000 deg. Fah. The material can be used for building up the worn cutting edges of lathe tools, milling cutters, drills, bits, dies, &c., while new tools using ordinary steel in place of high-speed steel can be provided with a high-grade cutting edge. A series of tests carried out with a tool faced with "Toolweld" and another of ordinary design showed that under similar conditions the output of the former was more than twice that of the latter before regrinding was necessary. Moreover, it is estimated that the cost of the tools is about 20 to 25 per cent. less when the electrode method of construction is employed.

ACCORDING to a note in the *Chemical Trade Journal*, recent investigations at the Mellon Institute, Pittsburgh, have shown that by the use of aqueous dispersions of carbon black maximum darkening of concrete can be obtained with minimum pigment content (2 per cent. carbon black). Various physical tests on concrete containing 2 per cent. dispersed black have shown in every instance improved strength, this improvement being as much as 25 per cent. in some cases. It seems probable that these aqueous dispersions of carbon black will have a considerable use not only for darkening, but also for increasing the strength of all compositions, such as concrete, mortars, and artificial stone. Aqueous dispersions of carbon blacks for these purposes are being manufactured and sold under the name of "Hiblak." It has also been found that the addition of 2 to 5 per cent. carbon black to sulphur-sand compositions markedly improves the workability of the mixtures, and, furthermore, increases very appreciably their strength and stability.

Air and Water.

THE French seaplane "Commander Paris," claimed to be the largest machine of its kind in the world, in a recent test flight, reached a height of 20,000ft. in fifty-seven minutes.

AN agreement between the U.S.S.R. and the Republic of Czechoslovakia to establish regular air services between the capitals of the two countries was recently signed in Moscow.

THE United States Navy Department announces that it has been unable to determine whether a gust of wind or a structural defect caused the loss of the dirigible "Macon" last February.

THE new Dutch cruiser "De Ruyter," launched at Schiedam, is 606ft. 10in. long, 50ft. 10in. broad, with a draught of 16ft. She will be driven by turbines of 66,000 s.h.p., and her estimated speed is 32 knots.

OWING to the movements of warships in the Firth of Forth during the latter part of June, the "Mauretania" will not commence her last voyage to Rosyth, where she is to be broken up, until the beginning of July.

ACCORDING to a census taken by the Board of Trade of seamen and the vessels upon which they were employed on June 15th, 1934, there were 3853 steam, motor, and sailing vessels in service, employing 151,001 British, foreign, and Lascar seamen. The corresponding figures for 1933 were 3672 and 147,052 respectively.

WE are informed that the new Union Airway Company of New Zealand is to order aeroplanes and accessories to the value of £100,000 from British firms for the Dominion's air mail and passenger services. The purchases are to be made by Mr. N. S. Falla, a director of the company, who has recently arrived in this country.

IT is reported that Sir W. G. Armstrong-Whitworth Aircraft, Ltd., Coventry, is constructing a giant four-engined monoplane for Imperial Airways, which for its size will be the fastest aeroplane in the world. The new liner will accommodate some fifty passengers, or carry more than 3 tons of freight. Its engines will develop over 3000 h.p., and it is expected that the machine will have a cruising speed of at least 160 miles an hour.

THE Royal National Lifeboat Institution has decided to lay down a motor lifeboat for Port St. Mary, in the Isle of Man. She will be one of the light type of self-righting lifeboat, specially designed for stations where the lifeboat has to be launched off a carriage or the open beach. On service, with crew and gear on board, she will weigh 6¾ tons, and have a speed of over 7 knots. She will carry a crew of seven, and be able to take thirty people on board in rough weather. This boat will replace a pulling and sailing lifeboat. When she arrives the Isle of Man will have four motor lifeboats and one pulling and sailing lifeboat.

THE Douglas motor cycle factory at Kingswood, Bristol, has been purchased by British Pacific Trust for production on a large scale of aeroplane engines and accessories for military and civil aircraft. A close working arrangement with General Aircraft, Ltd., has been made, and the new inverted vee side-valve engine recently designed by this company will be one of the engines to be put into production at the Douglas works at an early date. Manufacture of the Douglas products will be continued, including the light aero engine which Herr Kronfeldt used in his glider on his recent successful flight from London to Paris.

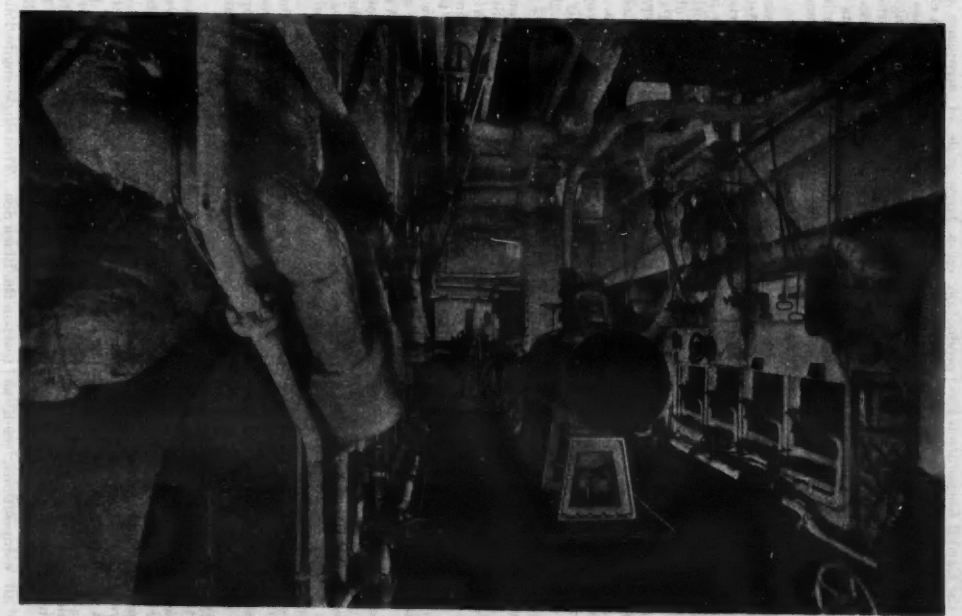
A NEW air service is shortly to be commenced by the Portsmouth, Southsea, and Isle of Wight Aviation, Ltd., linking the port of Southampton and Portsmouth with Paris in 1½ hours. Through the existing air ferry services operated by the company and those of other air lines already operating, passengers will now be able to travel direct by air for the first time between Paris, Bournemouth, the Isle of Wight, Bristol, Cardiff, Torquay, Plymouth, Newquay, Penzance, Nottingham, Leicester, Hull, and Grimsby without going through London. The service will be operated by Airspeed Lynx Envoy machines, capable of 175 m.p.h., and cruising normally at over 150 m.p.h. The route followed will be a straight line from Portsmouth to Le Bourget, a distance of 202 miles.

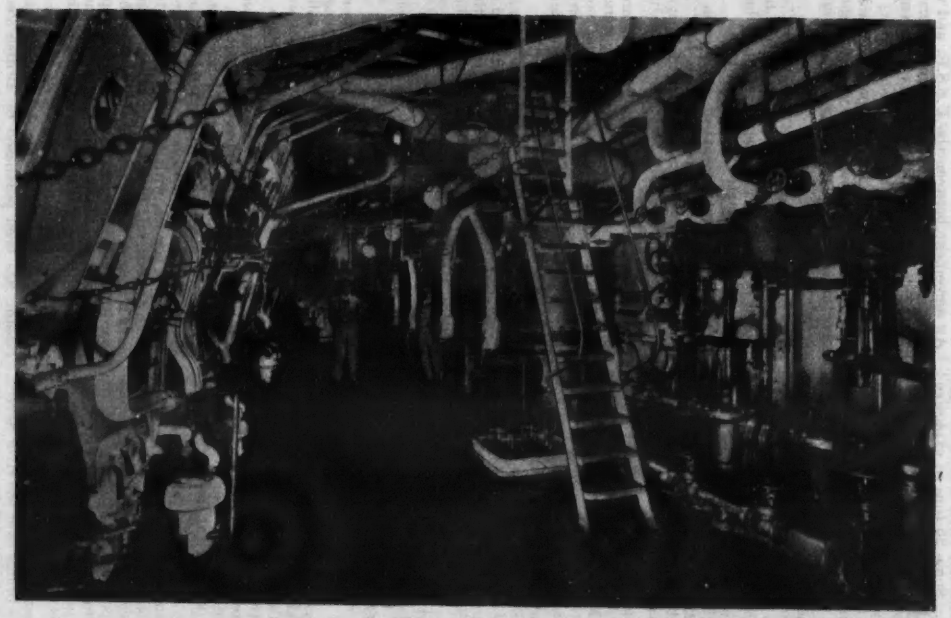
SPEAKING at a conference on Smoke and Aviation, recently held in London by the National Smoke Abatement Society, Mr. Alan Goodfellow said that with a light wind from the south-east the smoke belt from Manchester and south-west Lancashire can be traced as a streamer right up to the western Solway and across towards Ireland. Actually, such a belt has been traced over a distance of 200 miles by meteorological observers. With a similar very light wind, the smoke from a cottage on the edge of Woodford aerodrome has spread across the aerodrome, forming a belt only a few feet deep, but so bad as to make it necessary to suspend instruction in landing practice. Whatever the meteorological conditions, it is always noticeable that in and near the industrial areas the visibility is poor. It would not be fair to lay the blame entirely on the smoke nuisance. The difference in temperature over the cities must itself tend to encourage condensation and the formation of water vapour.

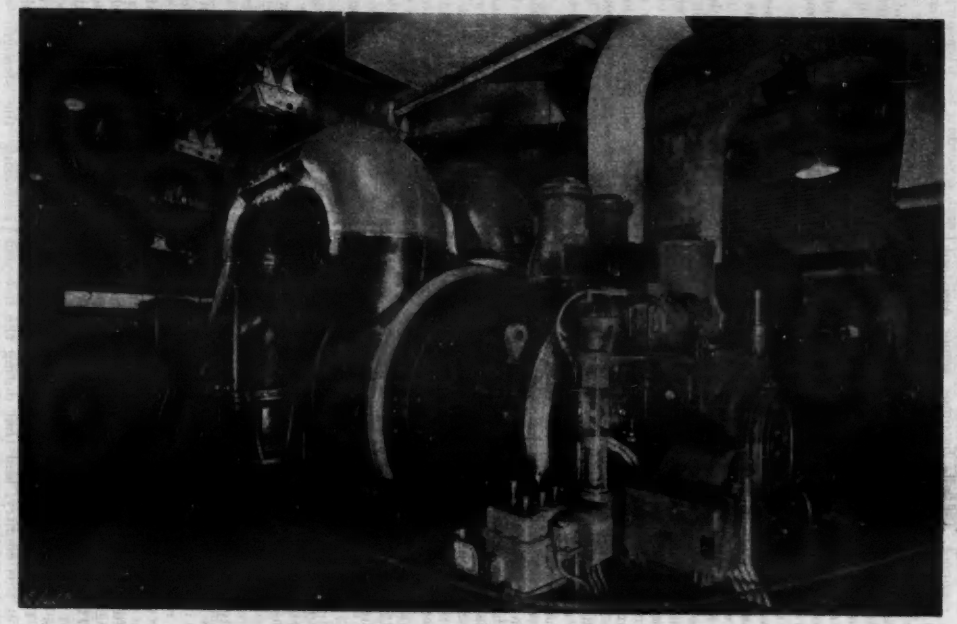
THREE new types of Soviet aeroplanes are announced in the *British Russian Gazette and Trade Outlook*, which states that the Scientific Research Institute of Aeroflot has concluded final tests of the new aeroplane "Kh. A.I.-I" constructed by the Kharkov Aviation Institute. This is the first Soviet high-speed mail-passenger plane with a speed of 326 kiloms. per hour. Built to carry six passengers, this machine is of all-wood construction and propelled by an engine made in the Soviet. The first seaplane "M.P.-I" has been completed, and has passed its tests on the Black Sea. This single-engined machine, which is capable of carrying six passengers, is so made that special ski runners can easily be affixed to the floats, thus allowing the machine to be used in the winter season when the waterways are frozen. Another new machine recently tested is the "Stal 3," constructed of rustless welded steel throughout. It can take six passengers, in addition to a crew of two, and has a cruising speed of 190 kiloms. per hour, with a maximum speed of 230 kiloms. per hour.

THE C. G. T. LINER "NORMANDIE"—BOILERS AND GENERATORS

(For description see page 622.)







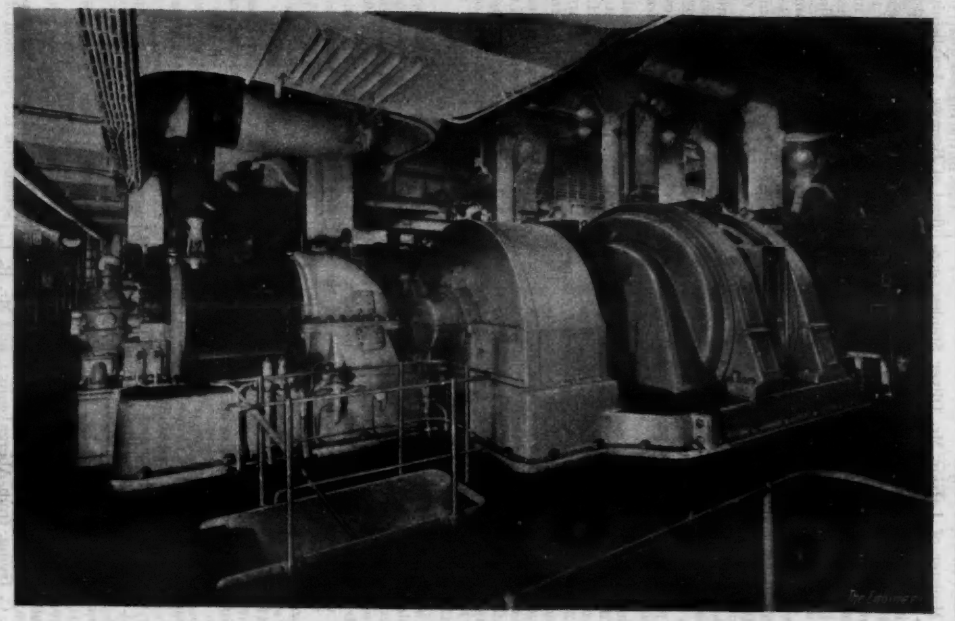


FIG. 12 (ABOVE):—NO. 3 BOILER ROOM—WATER-TUBE BOILERS
FIG. 13 (BELOW):—MAIN TURBO ALTERNATORS

FIG. 14 (ABOVE):—NO. 2 BOILER ROOM—CYLINDRICAL BOILERS
FIG. 15 (BELOW):—AUXILIARY TURBO GENERATORS IN MAIN ENGINE ROOM

The Engineer

JUNE 14, 1935.

VOL. CLIX. No. 4144

Contents.

THE ENGINEER, June 14th, 1935. PAGE

A SEVEN-DAY JOURNAL ... 609
MAJOR DOUGLAS'S SOCIAL CREDIT PLAN. No. I. ... 610
KING GEORGE V GRAVING DOCK, PUMPING PLANT AND EQUIPMENT. No. II. (Illus.) ... 611
SYMPOSIUM ON THE WELDING OF IRON AND STEEL. No. V ... 613
THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM. No. V. (Illus.) 616
LETTERS TO THE EDITOR—
Skilled Labour—Social Credit ... 618
SIXTY YEARS AGO ... 618
RAIL AND ROAD ... 619
AIR AND WATER ... 619
MISCELLANEA ... 619
LEADING ARTICLES—
Suburban Railway Electrification ... 621
Dams on Permeable Foundations ... 622
COMPAGNIE GENERALE TRANSATLANTIQUE LINER "NORMANDIE." No. III. (Illus.) ... 622
THE NATIONAL ELECTRICAL CONVENTION ... 625
ELECTRICITY SUPPLY, 1932-33 ... 628
THE INSTITUTE OF MARINE ENGINEERS ... 628
A HUGE EARTH DAM IN AMERICA. (Illus.) ... 629
THE MECHANICAL HANDLING OF FREIGHT TRAFFIC ... 629
SOUTH AFRICAN ENGINEERING NOTES ... 629
RAILWAY RATING PRINCIPLES ... 630
BRITISH STANDARDS INSTITUTION ... 630
MARKETS, NOTES AND NEWS ... 631
CURRENT PRICES FOR METALS AND FUELS ... 632
FRENCH ENGINEERING NOTES ... 633
BRITISH PATENT SPECIFICATIONS. (Illus.) ... 633
FORTHCOMING ENGAGEMENTS ... 634
PERSONAL AND BUSINESS ANNOUNCEMENTS ... 634
CONTRACTS AND ORDERS ... 634

NOTICES TO READERS.

**** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

**** *For Subscription rates, see page 2 of Advertisements.*

**** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS.

**** *Will subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new addresses,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

SUBURBAN RAILWAY ELECTRIFICATION.

IN August, 1916, eight months before the United States declared war on Germany, it was considered advisable that the President should have control of the railroads in that country, similar to the Government control over the railways of this country. The latter had been taken in August, 1914, under a minor section in a then little known piece of legislation. Whilst it was, at the time of its passage, known as the Cardwell Act for the abolition of Army purchase, it had the prosaic title of the Regulation of the Forces Act, 1871. In Section 16 of this Act it is enacted that an Order in Council, should a state of emergency arise, could transfer the possession of the "railroads" and their plant to the State. In the first article, on September 13th, 1918, of our series "British Railways under War Conditions," we pointed out that the section in question was a paraphrase, even to the term "railroads," of an Act passed by the United States Congress in 1862, at the time of the Civil War. Those American powers lapsed when that trouble was over and there was no necessity for the formal repeal of the Act. Coming to the events of the Great War, it was recognised, as said above, that powers of control should be given, but since, as President Woodrow Wilson remarked, "The President can do what Congress cannot do," the power was, as in 1862, vested solely in the President. A parallel is presented by a recent event in this country, where it has been shown that what the railways and the London Passenger Transport Board cannot do, the Government can. We refer, of course, to the electrification scheme for some of the suburban lines in London, the construction of new tube railways, and of engineering works on the former Metropolitan Railway. For the last dozen or more years it has been admitted, even by the railway companies concerned, that increased transport facilities are required for the traffic into and out of Liverpool-street, and, to only a slightly lesser degree, into and out of King's Cross. Hope of relief came with the establishment of the London Passenger Transport Board, but its financial resources are limited where suburban railways are concerned, as they come under a Joint Standing Committee of the Board and the four main line companies, and the latter are not, at the moment, sufficiently strong financially to undertake an expenditure of £35,000,000. The Government, as announced by the Chancellor of the Exchequer on Wednesday, June 5th, has ensured the payment of the interest for a period of five years. This is the third time within six years that the Government has so helped the railways. The latter had had, since 1832, to pay the railway passenger duty. That was modified under the Cheap Trains Act, 1883, which conceded workmen's fares, so that thereafter the duty had only to be paid on first-class fares. After years of protest that the duty—which had to come out of the companies' own pockets—was iniquitous, the Finance Act, 1929, cancelled it on condition that a capital equivalent of the relief be spent on the development and modernisation of railway transport. As typical of what was then done, it may be said that the Southern Railway Company anticipated that it would have to spend over £2,000,000, so undertook the further electrification of the Brighton line from Coulsdon onwards to Brighton and Worthing. Under the Development (Loan Guarantees and Grants) Act of the same year the conditions were reversed, as it was then the Government which was the suppliant. That was shown by the remarks made by the late Lord Churchill at the Great Western meeting on February 26th, 1930. He said that the companies were asked by the Lord Privy Seal, Mr. J. H. Thomas—an old Great Western man—whether they could put foward any proposals for assisting the Government in its schemes for the relief of unemployment. The Great Western, for example, had, as a result, assistance for a period of not exceeding fifteen years for such works as the enlargement of Paddington and Cardiff stations and the reconstruction of that at Bristol. The Southern proceeded with the second stage of the Southampton Docks extension, at an estimated capital cost of £2,500,000, and the new graving dock there at a further expenditure of £1,645,000. That Act expired in 1931.

The present proposals, which have secured the support of the Government, include the electrification of the former Great Eastern Railway from Liverpool-street to Shenfield—where the Southend branch leaves the main line; from Stratford to Loughton; and the Grange Hill branch from Woodford to Seven Kings. The Central London Railway is to be extended, in tube, from its terminus at Liverpool-street to Stratford. This will give a service from an exchange station at the latter place through the shopping and theatre area up to Shepherd's Bush, and, as we will show in a moment, still farther. Let us here remark that the late Sir Henry Thornton discussed with us a junction between the Central London and the Great Eastern soon after his arrival in England in 1914. That line, at its western end, is joined on to the Great Western's Ealing and Shepherd's Bush line, which has a junction with the same company's Northolt line at North Acton. The latter line is to be widened and electrified as far out as Ruislip, thus making a valuable through west-east service. What used to be called the Great Northern and City line, but is now the L.P.T.B. Northern City section, which runs as an independent line, but of standard gauge dimensions, from Moorgate to Finsbury Park, is to be brought up to the main line level at Finsbury Park whence the L.N.E.R. branch line that radiates to Edgware, High Barnet, and the Alexandra Palace, is to be converted to electric traction and permit through services between Moorgate and those outlying places. The Euston and Highgate tube, which now terminates at the latter point, is to be extended so as to join the just-mentioned L.N.E.R. branch at East Finchley and so give entirely new communication between the northern suburbs and the area served by the Charing Cross, Euston and Hampstead Railway, which extends as far south-west as Wimbledon and Morden and has interchange stations for the main line termini of Euston, St. Pancras, King's Cross, London Bridge, Charing Cross, and Waterloo. The tiresome bottle-neck of the former Metropolitan Railway, which gives only two lines of way between Finchley-road and Baker-street, was to be remedied—by powers given to the Metropolitan in 1926—by a tube from Willesden Green to Edgware-road. That work was never proceeded with by the Metropolitan, but is now to be undertaken by the L.P.T.B. and forms part of the present proposals. It will give direct access from the main line of the former Metropolitan to the south side of the river. Included in the scheme for financial assistance are the works on the Metropolitan for which the L.P.T.B. seeks powers in its own Bill now before Parliament. They cover the carrying of the electrical services which now end at Rickmansworth, on through Chorley Wood to Amersham, and to extend the four lines of way, which now end at Harrow, up to Rickmansworth. What may seem a weakness in the scheme as a whole is that, whilst the junction with the Northern City Line will permit of electrical services between Moorgate and the north-western area served through Finsbury Park, steam-worked trains will have to run from Finsbury Park to King's Cross, Farringdon-street, and Aldersgate. We do not know why that is so, but it has to be recognised that with such an improved service to Moorgate the number of passengers that remain to be dealt with by the three intermediate stations named will be comparatively very small and would hardly pay for electric traction if it were carried through the main line station at King's Cross on its way to the Widened Lines between King's Cross (Met.) and Moorgate. The L.N.E.R. main line station at King's Cross and the tunnels in the approach to that station form a very congested area, through which the whole of the freight traffic and the occasional special passenger trains to and from the Southern Railway—which formed a most valuable means of north-south through communication during the war—have to pass. At night there is a continual flow of freight traffic, which has to be operated by steam locomotives between the exchange sidings on the L.N.E.R. main line and those at Hither Green on the Southern. It is the lack of knowledge of such difficulties as those, just related, at King's Cross which makes some people wonder why schemes for electrification that look so simple are not undertaken. Others point to the admitted success on the Southern, but we have Sir Herbert Walker's own testimony—see our leader of January 18th last—that it should not be assumed that equal results could be obtained from the electrification of railways in other parts of the country, and even in London. Being a "passenger line," the Southern had been able to devote the whole use of its railway to passenger traffic during the greater part of the day; he did not know any other system in the country to which that applied. Mr. Alan Chorlton has often urged and again referred to it in a letter in the *Manchester Guardian* of Saturday last, June 8th, that the Manchester South Junction and Altrincham electrification, with its great increase in traffic, should be extended. Therein lies an excellent scheme—on paper. It is to continue the South Junction electrification along the old L. and Y. line from Ardwick Junction to Miles Platting, and, by Oldham, Rochdale, and Heywood, to join the Bury, Prestwich and Manchester electrification, completed in 1916. But such conversion, to be successful, demands a punctual and a much more frequent service of trains and the crossing of electrical trains from London-road, M.S.J.A., station on the west to the Beswick branch on the east would seriously interfere with the L.M.S. expresses to and from Crewe and the L.N.E.R. to and from Sheffield. At Miles Platting electric trains would interfere with the east-west service through Huddersfield, and at Rochdale with those *via* Halifax and *via* Wakefield. Freight traffic, to many, may seem a minor matter, but in these days of intense competition by road it is as important as the passenger traffic, and an increase of anything from 100 to 300 per cent. in the number of passenger trains means the more frequent side-tracking of goods trains and a greater occupancy of the line, which is bound to react more on the freight than on the passenger trains. These difficulties in relation to the Manchester area are also to be found in the Leeds, Bradford, and West Riding district. A more practical scheme, and one that was at one time contemplated, is the conversion of the L.M.S. Wirral Railway. The Wirral Peninsula offers a fine scope for the development of suburban traffic, and since it is without the problems we have alluded to, could be operated in connection with the Mersey Railway.

Hopes have been expressed that Government aid will be granted to other schemes for the improvement of the railways. For that there are now ample precedents. We have mentioned above the greater present-day value of the freight traffic and the greater need for its quick transit. Help for the companies towards the latter end would be indirectly beneficial to the trader and such help could be given by contributions towards the cost of widenings, deviation lines, &c. The L.M.S. Company has powers for over 150 miles of widenings and additions that have been authorised by Parliament, but not begun; among these, by the way, is the nearly nine miles of deviation to avoid Shap Summit. The pooling of competitive traffic

would allow all the traffic to be handled at one station in a town instead of at two, but, as we remarked in a leading article on June 3rd, 1932, that means expensive physical junctions to bring the other competing company's lines into the selected station. What is wanted is a revival of the grants, already referred to, made under the Development Act. Seeing what is being done almost daily for the improvement of the roads, such help for the railways would seem to be fully justified.

Dams on Permeable Foundations.

WE received recently from India a copy of one of the publications of the Central Board of Irrigation. It calls attention to the difficult problem of water pressure below structures on permeable foundations. The Central Board was established by the Indian Government some five years ago, and has already issued from Simla several reports of technical interest to engineers engaged on irrigation and other works of hydraulic character. The publication before us—"Pressures Below Works on Permeable Foundations," by Mr. A. N. Khosla, I.S.E.—deals with one of the first subjects selected for investigation when the Board was formed in 1930. The flow of water beneath structures founded on permeable soils has long been recognised as a determining factor in design. Until recent years the theories of W. G. Bligh have been accepted generally, at all events in India, but more recent investigations seem to indicate that the subject is far more complex than his simple assumptions. Renewed attention was directed to the question of the flow of water under the floors of river barrages in the course of the discussions on papers read in 1931 before the Institution of Civil Engineers by Mr. A. R. Ellison, describing the Nag Hamadi barrage in Upper Egypt, and by Sir Bernard Darley on the Sarda Canal works. The research work of Mr. E. W. Lane carried out in Colorado has also been described in papers recently published by the American Society of Civil Engineers. At Stockholm, in 1933, the International Congress on Large Dams devoted considerable attention to the subject, papers being contributed to the proceedings by several engineers of European reputation, including Professors De Vos, Smrcek, Pavlovsky, Körner, and Rehbock, the latter well known for his research work at the Karlsruhe laboratory. The matters dealt with in these papers and in the discussions thereon extended over a wide field, special emphasis being given to electrical methods of investigation on actual works as well as in connection with model experiments. A year ago the executive of the International Commission on Large Dams included in its list of special problems for investigation and research such matters as the determination of saturation lines and the prevention of the formation of leakage planes; methods of measurement, both by direct and electrical means, of water pressure; and the effects of capillarity in the hope that useful results might be available at the next International Congress proposed to take place in 1936.

Mr. Khosla's report records in detail the experimental work and routine observations made by means of a large number of pressure pipes at the Panjnad headworks. His work has led him to the conclusion that the change of viscosity due to temperature has a marked effect on the rate of flow, and, therefore, on the resulting hydrostatic pressures below works on permeable foundations. Recent laboratory experiments at the Lahore Research Institute have confirmed this conclusion qualitatively. The effect of temperature on uplift pressure is, of course, no new discovery, and is connected with the relation between temperature and capillarity. It was observed by H. de B. Parsons, in connection with the Sherman Island Dam. His conclusions and the results of experiments carried out by the United States Bureau of Reclamation were described in papers read before the American Society of Civil Engineers in 1929. Mr. Khosla's work does, however, carry the matter a stage further and the laboratory results supporting it are of importance. He gives full details of the instruments used for recording pressures, water levels, and temperature, and describes suitable arrangements for their economical installation in new works. The Board of Irrigation proposes, in the absence of other standards, to adopt the methods and instruments described, at any rate as a basis, for investigation and record in future works. Mr. Khosla also deals with the effects on percolation of seasonal variations in the nature and extent of silt deposits on the river bed above the weir or dam.

The interest taken in India and Egypt in this problem of the flow of water under pressure in pervious strata and its special importance in connection with engineering construction in those countries, seem to us to be sufficient reason to suggest that comprehensive reports fully covering recent research and investigation, both on actual works and in the laboratory, in India and Egypt, should be prepared for discussion at the next International Congress. At Stockholm two years ago, the enlightenment thrown on the subject came almost entirely from sources in Continental Europe. Very many dams and weirs have been built by British engineers in the East and Near East in the course of the past twenty years, and the difficult problems to which we have referred have been present in a large proportion of the works. These problems, particularly in recent years, have been closely studied by workers in the British Empire, in the laboratory as well as in the field, and the results of their labours should be available to the world at large equally with the important investigations of Continental research workers and engineers. With this object in view the research committee of the Institution of Civil Engineers, which has recently been reconstituted, might well give consideration to the matter.

Compagnie Generale Transatlantique Liner "Normandie."

No. III.

(*Continued from page 598, May 7th.*)

IN our two previous articles we have dealt with the hull construction and the propelling machinery lay-out, and have described the measures taken for protection against the dangers of fire or flooding. We now propose to describe briefly the ventilating and heating systems, and the navigation equipment, and then to pass on to the details of the boiler and propelling machinery installation.

VENTILATING AND HEATING.

The whole of the main ventilating and heating equipment was designed and supplied by Thermotank, Ltd., of Govan, Glasgow, the special ducts and trunking required being made at the Penhoët shipyard, St. Nazaire.

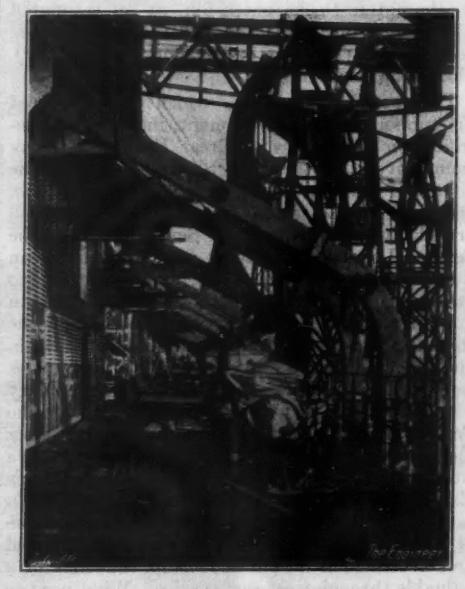


FIG. 16—BOAT DECK

With the exception of the first-class dining-room, and the engine and boiler-rooms, the ventilation of all the other quarters of the ship is effected by one of the four following processes:—Low-pressure ventilation by air which can be heated; high-pressure ventilation by a mixture of hot and cold air; high-pressure ventilation hot or cold air; and high-pressure ventilation by cold air. The low-pressure ventilation is used in practically all the first-class public rooms. High-pressure ventilation, by a mixture of cold and hot air, is made through louvres or on the Thermo-reg system or through temperature regulators. Thermo-regs are used in the cabins, sanitary services, first-class passenger and officers' accommodation, and temperature regulators in the first-class alleyways and public rooms and hospitals not having low-pressure ventilation.

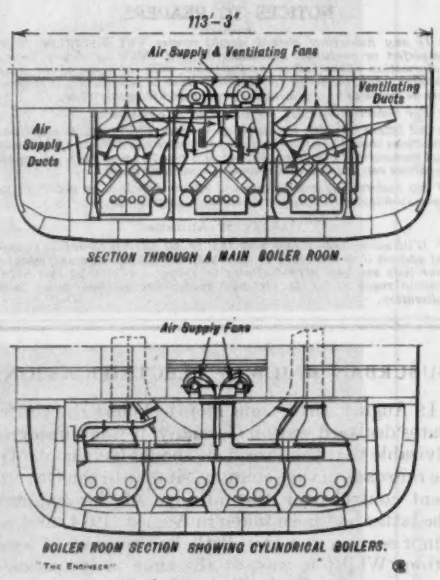


FIG. 18—ARRANGEMENT OF BOILERS

High-pressure ventilation by hot or cold air is effected through punkah louvres and is used in the tourist, third-class, and crew's accommodation, while high-pressure cold-air ventilation is effected by louvres or diffusers in the kitchens, bunkers,

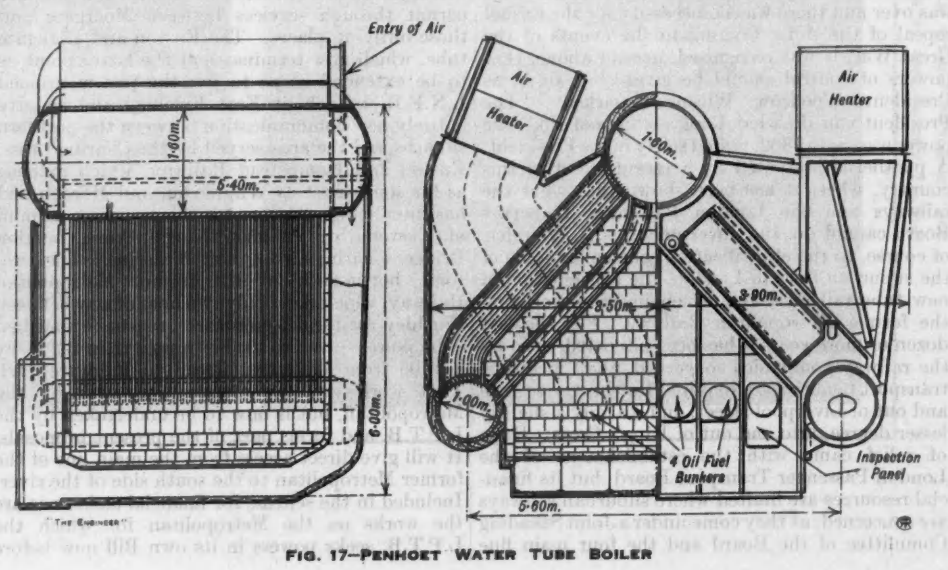


FIG. 17—PENHOET WATER TUBE BOILER

'tween deck spaces, store rooms, and electric-panel compartments, in which heat-producing machinery is placed.

In all there are over 160 individual air-conditioning thermotanks, and fans, all of which are housed in special sound-proof compartments grouped at suitable positions throughout the ship. In Fig. 16 we reproduce a view of part of the boat deck, showing some of the intake louvres of the special thermotank and fan rooms. By adopting this arrangement, which is generally similar to that of the liner "Champlain," deck spaces entirely free from ventilator cowls or fan

FIG. 19—MAIN CONTROL STATION

FIG. 20—SWITCHBOARD AT MAIN CONTROL STATION

casings have been obtained, which may be regarded as an outstanding feature of the "Normandie's" design.

The total output of the various motors employed in connection with the ventilating and heating systems exceeds 1500 h.p. The fan motors, over 160 in number, ranging from 3 to 17 h.p., were supplied by the General Electric Company, Ltd., of London and Witton, to a special specification prepared by Thermotank, Ltd. Both the motor and fan units are both statically and dynamically balanced and are mounted on anti-vibration bases. In addition to the systems enumerated above, there are also numerous steam and electric radiators in the various compartments.

The air-conditioning installation for the first-class dining saloon, which has a volume of about 61,600 cubic metres, was designed and supplied by the Société Continentale Carrier, and it comprises air-washing and cleaning plant, large enough to deal with 98,000 cubic metres of conditioned air per hour. This air is delivered to the upper parts of the room at a low pressure and passing through no less than 9060 vents, it falls slowly to the bottom of the room, whence it is removed through eighty-two intakes concealed behind the panelling. The air-conditioning plant for this single room requires 310 h.p. to drive it, and the associated refrigerating plant for cooling the air has about three times the capacity of that installed for domestic and hotel services.

VARIOUS TRANSMISSION SERVICES.

Verbal communication throughout the ship is made by means of telephones and loud-speaking telephones, while written communications are made through an extensive system of pneumatic tubes. In addition, there is the usual call bell system for cabins.

The telephone system for the passengers and staff includes four exchanges, three for the passengers and one for the staff. The first three embody 650 lines and the fourth 120 lines. Loud-speaking telephone installations have been provided to ensure communications between the different services concerned with the navigation and manœuvring of the ship. They comprise twenty-four posts, four of which can be used as emergency posts. These loud-speaking telephones connect the bridge with the forward manœuvre posts, propelling engines, windlass section forward, crow's nest, steering gear compartment, gyroscopic compass compartment, and the boat deck, and also the oil-bunkering compartments with the transfer pumps section aft; the panel of the main circuit-groupings panel to the main low-tension turbo-generator panel; the propelling machinery manœuvring panel to the boiler-rooms, the main condenser station, the chief engineer's office, and the propelling motor manœuvring control station. Other order-transmitting systems include an order transmitter from the bridge to the steering gear, with repeater; four order-transmitting apparatuses from the bridge to the engine-rooms which are used two by two alternately; four propeller-position indicators; four repeaters of the number and direction of the propellers, and a special apparatus recording graphically the number of revolutions and the direction of rotation of the propeller shafts. This apparatus consists of four transmitters and four receivers, one for each shaft. The four receivers are grouped in one box with a common recorder.

Two complete sets of wireless telegraph equipment are carried, a forward station near the bridge for ship use, and a station aft for passengers' use. The installation includes long and short-wave transmitters for telegraphy and telephone, and a pick-up apparatus for music transmission. The installation was supplied by Cie Radio Maritime.

NAVIGATION EQUIPMENT.

A large part of the navigation equipment was supplied by S. G. Brown, Ltd., of Acton, and this comprises the gyro compass and automatic helmsman, with a combined rudder angle and course recorder. In addition to the Brown gyro compass there are seven repeaters, and a Carpentier gyro compass, with four repeaters, the first apparatus of its kind on a mercantile ship. Other instruments on the bridge and in the chart-room include a Langevin-Florisson ultra-sonic sounding machine with a Marti recorder; a Marti percussion depth sounder, with two depth sounders of the Kelvite heavy-duty pattern, and one Pneumercator-type draught recorder. The latter instruments were supplied by Kelvin Bottomley and Baird, Ltd., of Glasgow. The logs include an S.A.L. log of the Pitot tube type, with an indicator, and a propeller type log with speed and distance recorder, while, in addition to the radio position finder, there is a complete fog bell and gong equipment. The two main syrens of the ship are of the steam Tyfon type, and are fitted on the forward funnel; there is another steam whistle on the after funnel. We may remark on the very roomy bridge and its convenient lay-out with overhung side positions, giving a full view of the whole 1000ft. length of the ship.

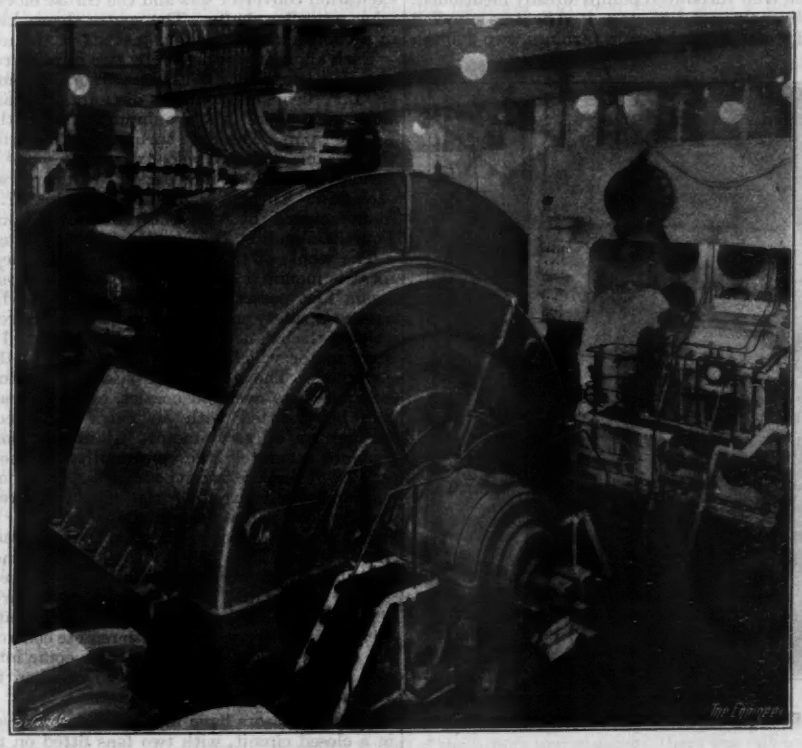


FIG. 21—ONE OF THE FOUR PROPELLER MOTORS

BOILER INSTALLATION.

As shown in the plan reproduced on page 562 *ante*, and in Fig. 18, the boilers are grouped in four rooms. The complete plant comprises twenty-nine main water-tube boilers and four auxiliary boilers for heating make-up water and domestic services. The steam from the auxiliary boilers supplies the air ejectors, the turbine jacket steam and the feed-water heaters. An arrangement for return condensate from the domestic water heaters is also provided. These boilers have a diameter of 5·40 m., or about 17ft. 8in. each, and a working pressure of 10 kilos. per square centimetre, or about 142 lb. per square inch. They are each fired by two furnaces equipped with Wallsend oil burners and fuel supply plant. There is also a small auxiliary condenser and distiller for use when in port or when water supplies are not suited to boiler feeding.

The main boilers (see Fig. 17) are of the Penhoët water-tube type, and are identical with those on the "Champlain." They have a working pressure of 28 kilos. per square centimetre, or about 400 lb. per square inch, and the steam is superheated to 360 deg. Cent., or about 689 deg. Fah. They have three drums, and the integral superheaters were supplied by the Compagnie des Surchauffeurs. Tubular air heaters are installed, and, as Fig. 17 shows, air circulates in the casings around the boilers. For cleaning all the tubes, including those of the air heaters, permanent Paradox blowers, made by the Etablissement Gattegno, are provided, and they operate with superheated steam. All the external surfaces of the boilers are covered with mattresses of glass-silk insulation. Each boiler has two safety valves and each superheater can be separated from the boiler by a non-return valve with distant emergency control made by Cockburns, Ltd., of Cardonald, Glasgow, and there is also a valve of the same type at the outlet from each superheater. As the usual design of water level gauges would have been inconveniently high, the levels are indicated by grouped distant reading gauges of the Kelvin, Bottomley and Baird pattern,

working in a similar manner to the Pneumercator gauge. The oil-burning equipment is of the Penhoët pattern, and each boiler has four burners. Each of the groups of boilers has an oil pumping and heating set and there are four extra sets for standby purposes. The Guinard oil fuel pumps are driven by electric motors and the filters and heaters are of the Penhoët type.

Air is supplied to the boilers by twenty-one fans, each having a capacity of 55,000 cubic metres, or about 2,000,000 cubic feet per hour. They were supplied by James Howden and Co., Ltd., and are driven by Alsthom motors. All the boiler fans are installed in a 'tween deck space and are controlled from the boiler-room floors. There are six main feed pumps, supplied by G. and J. Weir, Ltd., of Cathcart, one for each main set and two spares. They are of the two-stage type designed to deliver 200 tons of water per hour against a pressure of 334 lb. per square inch and at a temperature of 617 deg. Fah. The two 75-ton feed pumps for the auxiliary turbo-generator sets are also Weir two-stage machines.

The ventilation of the boiler-rooms is effected by fourteen fans supplied by Granoux, driven by Alsthom motors. The auxiliaries installed in the boiler-rooms include bilge, ballast and transfer pumps, distilling and condensing plant. There are, we noted, besides the Weir turbo-feed pumps already mentioned, which deliver through two-stage feed heaters supplied with bled steam from the main turbines, two 300-ton

FIG. 24—ONE OF THE PROPELLERS

bilge pumps of the Drysdale type, supplied by Ateliers et Chantiers de la Loire, with Alsthom motors; two ballast pumps of 500 tons capacity, of the same make, and two 180-ton oil fuel transfer pumps of the Birotor type, supplied by the Société Alsacienne de Constructions Mécaniques. Two reciprocating steam pumps of 50-ton capacity, for feeding cylindrical boilers, and one water heater made by the Ateliers et Chantiers de France, are installed, and four evaporators of 75 tons each and one distiller condenser of 20 tons supplied by Ateliers et Chantiers de Bretagne, are included in the boiler-room auxiliaries. There is also one auxiliary condenser constructed by Penhoët and built to Weir design, two electric 20-ton Bréguet pumps for the transfer of distilled water, and an oily water separator supplied by the Société Provençale de Constructions Navales.

In order to provide for the complete independence of the machinery driving each propeller shaft there are five superheated steam mains. Four of these are for the main turbo-alternators and the fifth for the auxiliary D.C. turbo-generators. Extensive use has been made of the Aiton corrugated pipes, which were supplied by the French Aiton company, Société de Constructions Aiton of La Courneuve, Seine.

MAIN PROPELLING MACHINERY.

Each of the four propeller shafts is driven by a three-phase synchronous electric motor. Current is supplied to these motors by four turbo-alternators, which are quite independent, and cannot be coupled in parallel, although the two motors driving the propeller shafts on one side can be driven by either of the turbo-alternators on the same side, which improves the efficiency at reduced power. The propelling machinery is installed in two compartments with a double shell at the sides. In the forward compartment (see page 620) are the four turbo-alternators, with their condensing and lubricating equipments, the switchboards and manœuvring panels, and also the cubicles in which the whole of the high-tension electrical equipment is enclosed. In the other compartment aft there are the four propelling motors with their cooling and lubricating installations, the excitation converter sets and the thrust blocks of the wing propeller shafts. The centre thrust blocks are in a compartment situated just aft of the motors.

Each alternator is driven by two impulse turbines; one H.P. turbine with the governor equipment and one L.P. turbine designed to discharge into an underslung condenser. The maximum speed of these sets is 2430 r.p.m. The H.P. turbine has thirteen wheels, the first one with two velocity stages; while the L.P. turbine is of double-flow design, with three wheels in each flow. Turbine blading of Hadfield A.T.V. steel, manufactured by the Soc. Anon. de Commentry Fourchamboult et Decazeville, is used throughout.

The whole of the governor and emergency equipment is mounted over the h.p. turbine bearing; the steam first passes through a stop valve which also acts as a safety valve, then passes into a regulating valve of the balanced type controlled by an oil pressure servo-motor which itself is controlled by the speed governors. The steam then passes to the nozzles or, if required, to overload nozzles, each overload nozzle box being fitted with an extra valve controlled through an oil servo-motor. It is thus possible to regulate accurately the consumption at the various speeds. There are two types of speed governor for the servo-motors controlling the regulating valve and the overload valves; a centrifugal governor allowing regulation with great accuracy of the steam admission at all speeds from 500 to 2430 r.p.m., and an oil pressure governor regulating the steam at speeds from 175 to 500 r.p.m. The speed control is varied from the manœuvring desk on the starting platform by means of an electric motor with remote control. There are emergency cut-outs designed to come into operation either with too high a speed or when failure of vacuum or oil pressure takes place.

The alternators have four poles and are ventilated in a closed circuit, with two fans fitted on the shaft of the alternator itself. The lubrication of the turbo-alternator is by gravity with two independent circuits, one on each side. In each circuit lubricating oil is pumped to gravitation tanks by three pumps driven by electric motors. The condensers, supplied by Société de Condensation et d'Applications Mécaniques, each have a surface of 2200 square metres, or 23,700 square feet. The tubes are of aluminium-bronze and were supplied by I.C.I. Metals, Ltd., and the Yorkshire Copper Works, Ltd., of Leeds. Circulating water is supplied by two centrifugal S.C.A.M. pumps having a capacity of 7000 cubic metres, or 247,000 cubic feet, per hour, running at 560 r.p.m. and driven by Alsthom motors. The air extraction from the condensers is effected by S.C.A.M. two-stage ejectors fed with saturated steam supplied by the cylindrical boilers. Each condenser has two ejectors, each one being designed to provide the required vacuum for normal power.

THE MAIN MOTORS.

Each propeller shaft is driven by a 40-pole motor with a rigid coupling, and there is a Michell thrust block between the motor and the shafting. The ventilation of the motors is in a closed circuit, and the lubrication of the motor bearings and of the thrust blocks is by gravity, with two independent circuits, one for each side. The excitation of the alternators and motors is effected by five exciter sets, one of which is kept in reserve, each of the other four being allocated to a shaft line. Each excitation set comprises a continuous-current electric motor, driving two generators, one supplying the excitation current to the alternator, the other supplying excitation current to the motor. In Fig. 22 we show the exciter and motor cooling controls in the main motor room and in Fig. 23 an exciter group.

FIG. 22—EXCITER AND MOTOR COOLING FAN CONTROLS

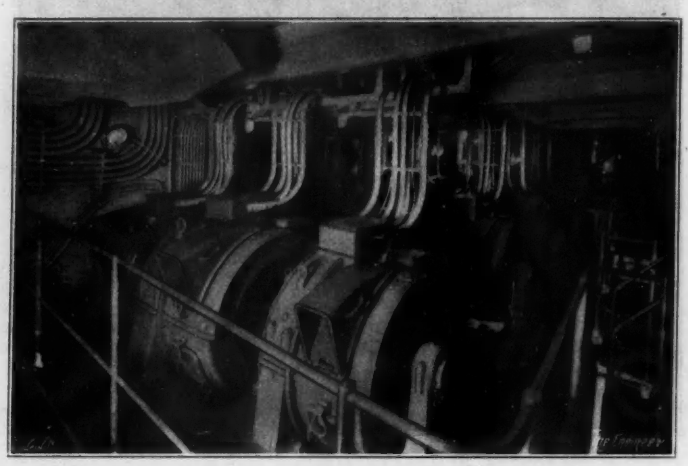


FIG. 23—GROUP OF EXCITERS

CONTROL AND MANŒUVRING SYSTEMS.

In Fig. 19 we show the desks of the main control station, which is arranged on a gallery at the after end of the main engine-room overlooking the four turbo-alternators and the six auxiliary generating sets. Above the desks are the engine-room telegraphs for the four screws. The automatic switchgear is incorporated with the control levers, and on the main switchboard behind the desks—see Fig. 20—there is provided the necessary equipment for hand operation should this at any time be required. The high-tension switchgear is arranged for the following two different circuits: firstly, for normal running conditions, in which each alternator drives the corresponding motor. With this circuit the four shafts are completely independent of each other, both as regards direction of rotation and speed. Secondly, for two alternators operating four screws. The two motors on the same side of the ship are each in parallel with one of the alternators on the same side. Independent auxiliaries are provided for each of the four shafts. Fig. 19 shows clearly the reverser excitation controller and the manœuvring levers. In order to start up, the following sequence of operations has to be made:—

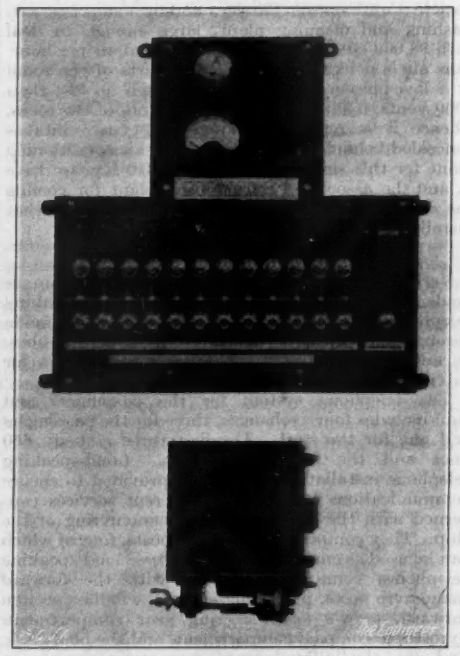


FIG. 25—SALINOMETER

After the desired circuit has been chosen and the main circuits completed, the alternator or alternators corresponding to the shaft required is brought up to a speed of about one-quarter of its normal running speed of 2428, namely, 607 r.p.m. The excitation of the alternator now starts the main propelling motor as an asynchronous machine and brings it to a speed of approximately 60 r.p.m. This speed having been reached, the rotor poles of the motor are excited, which ensures synchronous operation. The speed of the turbo-alternator set is now increased and from this moment on the speed control is exactly similar to that of the geared drive, having in this case a ten-to-one reduction. Each control desk—see Fig. 19—of which there are two, one on each side of the ship, is complete with the necessary instruments and speed indicators for both alternators and motors. There are two main control levers for each line of shafting, which are interconnected with and directly operate the controller drums. They consist of a reversing lever and a speed control lever, which can be moved into the positions corresponding to that necessary for the various manœuvres above described and can be employed to increase or decrease the speed of the ship as desired.

Auxiliary Generating Machinery.

The continuous current is supplied by six turbo-generator sets of 2200 kW each—see page 620—of which two are intended to supply engine-room auxiliaries and two the deck auxiliaries, while out of the other two, one is used for one of the above-mentioned duties, the other being kept for emergency. The turbines of these six sets are supplied with steam at 22 kilos. per square centimetre pressure and temperature of 325 deg. Cent., or 310 lb. per square inch and 617 deg. Fah., and they are coupled to the generators through gearing giving a reduction of 5130 to 530 r.p.m. The turbo-generator sets, as well as the main switchboards, were supplied by Alsthom; the switchboard for the distribution to "hull" circuits by Etablissements Merlin et Gérin, and the secondary switchboards by Société Brandt et Fils. There are two emergency generating sets installed in the deck-house of the promenade deck. They were supplied by the Société Generale de Constructions Mécaniques. Each set comprises a 235 h.p. M.A.N.-type oil engine driving a 150 kW generator supplying current at 220 volts. There are also various sets of accumulators for supplying emergency lighting and other circuits.

An auxiliary fitting of unusual interest is the Salinometer equipment supplied by W. Crockatt and Sons, Ltd., of Glasgow. The recording instrument and one detector box is shown in Fig. 25.

Crockatt Simplex patented Salinometers have been applied to twelve observation points—four main condensers, six turbo-generator condensers, one drain cooler, and one auxiliary condenser. The Salinometers are of the multi-point selective type, in which the readings from the various points under test are given on a central instrument or control board. The theory of the instrument is based on the electrical conductivity of the solution being tested, and, in the multi-point outfit, detector boxes are fitted near the various points to be tested. Each box contains a detector cell and a temperature compensator. The instrument board installed in one of the main engine-rooms is exceedingly compact, and mounted on it are the indicating instrument, interlocked selector switches, warning lamps, warning bell, relays, fuses, and a master switch, which controls the whole apparatus. Normally, the detector cells are all in circuit with the warning lamps, and should a sudden influx of salt take place at any point, the corresponding lamp will glow brightly, and if the impurity exceeds a predetermined amount, the relay will come into action and the warning bell will operate, ensuring the attention of the engineer in charge. When the water clears again the warning bell ceases ringing. When it is desired to record the actual impurity content the engineer sets the switch-locking lever and switches in each point in turn to the indicator, noting the reading in milligrammes per litre.

It is interesting to note that the switches are so interlocked that only one point at a time can be put in circuit with the indicator, and this switch must be replaced in its normal position before the locking lever can be moved to permit of another switch being operated. This arrangement ensures that all points are in continuous operation either through the lamps or the indicator.

The Propellers.

The four propellers—see Fig. 24—were all supplied by British firms to designs and specifications prepared by the builders of the ship, following extensive trials made in the Paris and Hamburg Experimental Tanks. Two propellers were constructed by the Manganese Bronze and Brass Company, Ltd., of London, and two by J. Stone and Co., Ltd., of Deptford. They have a finished weight of about 23½ tons, and a diameter of 4·90 m., or over 16ft. There are, as our illustration indicates, three broad blades, which have a varying pitch.

The Lubrication Systems.

The lubrication of the bearings of the turbo-alternators, propelling motors, and auxiliary geared turbo-generators is carried out on the forced feed system, and about 130 tons of oil are kept in constant circulation. From the service tanks the oil passes to the bearings and falls after use to the oil sumps, from which it is returned through a filter and cooler and is pumped back to the service tanks. When considering the lubrication of the whole of the machinery, an interesting problem had to be faced. While the lubrication of the gearing of the auxiliary turbo-generators called for a viscous oil, the bearings of the turbo-alternators called for a more fluid oil, while an intermediate grade of lubricant was required for the main motors. It was finally decided to adopt a single oil for the whole installation, and the Vacuum Oil Company's Gargoyle D.T.E. Marine Oil Heavy Medium was chosen, and it has, we are informed, given very good results. The oil meets the varied requirements above referred to, and its rise of temperature does not reach 15 deg. Cent. above that temperature which would have been obtained with a more fluid oil. For the purification of the oil there are four De Laval centrifugal separators of the latest electrically-driven type. Two of these machines deal with oil in the turbo-alternator system, in which about 11 cubic metres of oil are in circulation; the third machine serves the four main motors and deals with the 8 cubic metres of oil in circuit, while for the six turbo-generators the fourth machine deals with the 6 cubic metres of oil in the lubricating circuit.

(To be continued.)

The National Electrical Convention.

No. II.

(Concluded from page 591, June 7th.)

THE second session of the Convention was held on Wednesday, June 5th. Speeches were delivered by Sir Archibald Page, Messrs. P. J. Robinson, John Dalton, H. Marryat, Sir Felix Pole, Sir William Ray, and Sir John Brooke. Discussing distribution, Sir Archibald Page explained that it would be idle to pretend that all obstacles to low cost had been overcome. It was essential that the supply industry should devote more individual and collective thought to the subject of distribution areas. Immediate lessening of the average cost could be achieved by the amalgamation under enlightened management of some of the undertakings; but such management required the continuous recruitment of men of the highest technical and commercial ability who could only be attracted by the prospect of remuneration commensurate with that to be found in other branches of industry and commerce. It was also essential that closer study should be given to greater uniformity of price structure, methods of charging, service to the consumer, and the development of the supply of apparatus on easy terms. The Central Electricity Board had to look well ahead, and in less than two years arrangements had been made for generating plant extensions representing orders to a total value approaching 14¼ million pounds. Corresponding expenditure would be required by the authorised undertakers on transmission and distribution equipment, and quite apart from the new market for consumers' apparatus the manufacturing industry would benefit to the extent of 35 million pounds.

Speaking as the representative of the Incorporated Municipal Electrical Association, Mr. P. J. Robinson expressed the opinion that the pollution of the atmosphere was largely the cause of much of the sickness and disease in congested cities. By the more extensive use of electricity much ill-health could be prevented. The rapidity with which the use of electricity was extending was resulting in reduction of the selling price, but the deplorable lethargy which was exhibited by some undertakings was almost unbelievable. The engineer or manager of a concern should be made to realise his responsibility as regards progress or be suspended.

A matter that was bothering many at the present time was the quite unnecessary variation in the price charged for electricity in different parts of the country, and very often in adjacent areas which were only divided by imaginary boundaries. If that state of affairs was allowed to persist, it could only result in the strangulation of the real progress of which the industry was capable. One of the most satisfactory means of increasing the domestic load was the adoption of an attractive system for the hire and maintenance of the many types of apparatus used in the home. Standardisation of apparatus was essential. Largely as the result of the whims and fancies of particular individuals who had charge of the various undertakings, there were far too many types of apparatus in use. If an earnest endeavour were made to standardise apparatus, and those who desired to indulge in fancy principles were forced to pay a much higher price, advantages would be bestowed on the consumer and manufacturer alike.

Representing the Electrical Contractors' Association Incorporated, Mr. H. Marryat naturally dealt with matters affecting contractors. The adoption of the new edition of the wiring rules and the more general use of B.S.I. standards, would, he felt, lead to a better class of installation and more satisfied consumers without any material increase in cost. With installations planned upon standard lines, extensions and alterations would be more easily effected and safety assured. Great strides had been made in the way of clearing up the chaos of overlapping and trade abuses which once existed between manufacturers and retailers. The various associations had played their part in the work to the advantage of all. But in view of the growth and ramification of the industry and the fact that the final and biggest problems were now being tackled seriously, it appeared to be essential that a trade Parliament should be established with a properly paid executive to administer agreements and to form a court of appeal to settle misunderstandings. Apart from that central co-operating body, the Contractors' Association visualised a development programme based upon existing supply areas and planned by (1) the appointment of a development officer by the supply authority in each large area; (2) monthly meetings of a properly constituted "electric circle," and (3) campaigns designed to demonstrate the advantages of particular pieces of apparatus, such as cookers, water heaters, &c.

Sir Felix J. C. Pole, who represented the electrical manufacturers, began his remarks by explaining that whereas at the date of the first I.M.E.A. Convention the Islington station, containing four 125 kW generators, was a show station and that in the year 1910, a 3000 kW set was looked upon as a large one, a 105,000 kW machine would soon be working at the London Power Company's Battersea station. That demonstrated the phenomenal progress made by electrical engineers in the last two decades. To indicate the advances made in steam conditions, Sir Felix mentioned that a 24,000 kW turbine was recently manufactured in this country to operate at a pressure of 1760 lb. and at a temperature of 932 deg. Fah., while a slightly smaller machine, designed for a still higher pressure, was about to be built. Similar progress had been witnessed in connection with overhead and underground transmission, for pressures had been raised from a few thousand volts to 132 kV and more.

Investors who, twenty years ago, or even more recently, put their money on the generation and distribution side of the industry, had reason to feel far happier than those who backed the manufacturers. From a list of the twelve larger manufacturers it appeared that half of them had not paid a dividend on their ordinary shares, while with perhaps one exception (which was not due to the manufacture of large apparatus) dividends had been quite small. When he was general manager of the Great Western Railway no one could have induced him to believe that a manufacturer would undertake a large contract merely to keep men at work, but it was, nevertheless, a fact that during the last few years contracts had been accepted at less than factory cost. Such conditions were not good for industry. Competition had been worshipped too long. It had resulted in unnecessary additions to producing capacity, a large loss of capital; it had tended to reduce research and development, and even to impair efficiency. If one result of the Conference proved to be the bringing home of the fact that the British manufacturers of electrical apparatus were outstanding in their scientific achievements and were entitled to be paid adequately for their work, it would have served a sound and useful purpose.

The Executive Chairman of the British Electrical Development Association, Sir William Ray, speaking as the representative of that body, said that most of the large industries serving the public realised the importance of national publicity directed to educating the people to a full appreciation of the value and advantage of their service. Although the increased activity in national electrical propaganda had been accompanied by more vigorous propaganda by many of the supply undertakings, there was still ample room in many cases for more systematic business getting by supply undertakings. The standard suggested was that 1 per cent. of the gross revenue should be allocated to definite publicity purposes, apart from that devoted to showrooms, exhibitions, &c. In addition to such publicity, campaigns in the national Press and such special campaigns as the E.D.A. films, the Association organised electrical displays at exhibitions of a national character.

Through the medium of special committees on which representatives of manufacturers were included, it also carried out investigations into the development of special loads, such as cooking, water heating, industrial heating, street lighting, and electricity supplies to small dwellings. Reports issued on those and other subjects to members of the Association and for general circulation had proved of the greatest

value. In addition to its general publicity effort, the Association rendered numerous services to supply undertakings in connection with their local publicity. It assisted in the design and lay-out of showrooms, the organisation of local exhibitions and demonstrations, the preparation of newspaper advertisements, the planning of special campaigns, the supply of publicity material of various kinds, and in any other direction desired. The field of development covered by the Association might be conveniently divided into domestic, industrial, commercial, public service and transport applications. In every direction the outstanding feature was the immense scope for further progress.

Sir John Brooke, who represented the Electricity Commissioners, remarked that sixteen years ago when the Electricity Commission was established, only a few engineers realised the fundamental importance of electrical supply to industry, and predicted the growth that had been experienced. Largely as the result of predictions of Sir John Snell and his first colleagues on the Commission, recognition was secured to the principle that the industry should be planned on a national scale. Electricity was a public utility which could only grow to its full stature if planned and regarded as a national whole. Though great advance had been witnessed during the past sixteen years, much remained to be done.

Standardisation was inevitable. No engineer entrusted with the task of planning electricity supply again would divide the country into the present distribution areas, which were a definite handicap to all in providing the best possible service for the public. Much could be done to improve matters within existing statutory provisions. Uniformity in the methods of charge was desirable. A committee appointed by the Commissioners some years ago reported in favour of a two-part tariff for domestic supplies based on the area of the house, and it was gradually being adopted. It was to be borne in mind, however, that uniformity in methods of charge did not imply uniformity in charge itself. While it was the ideal of some that actual charges should be the same throughout the country and that the price charged to any individual should not bear relation to the particular cost of offering the service, in the opinion of the Commissioners that was not a practical ideal at the present time. In fixing tariffs, however, undertakings should consider the future and make allowance for the growth in load that the reduction in cost would provide.

A paper entitled "Industrial Power Supply," by Messrs. H. Hobson, F. Forrest, and C. D. Taite, was the first item on the programme of the third session, held on Thursday, June 6th. The authors examine the dependance of Great Britain upon manufacturing industries. Despite the progressive substitution of electric power for directly applied mechanical power, there is shown to be a large field for further development. The inherent advantages which have led to the great advance in the industrial use of the public electric supply service are discussed, and their cumulative effect upon economy of production demonstrated. Methods of accelerating the substitution of public electricity supply for private industrial power plant are also considered. Notwithstanding that the last decade has witnessed marked improvements, both in the price and in the availability of industrial electric power from the public supply, the authors believe that there is reason to expect that even greater strides will be made in the course of the next ten years.

After discussing the well-known advantages claimed for the grid, the authors explain that although the position as regards the supply of electric power has greatly improved during recent years, it is still far from satisfactory. The establishment of the grid, the paper continues, was due to the general realisation of the need for reorganisation. Prior to the war, parochial legislation and piecemeal development resulted in a chaotic medley of systems, frequencies, and pressures which stultified the development of public supply systems. Another reason for unsatisfactory development is shown to be the fact that the introduction of labour-saving devices has proceeded more slowly in this country than elsewhere, and mass production methods have not been so widely applied in Great Britain as they have been in such countries as America and Germany. From this, the authors conclude that there is a relative deficiency in the total power equipment of industry in Great Britain, as compared with her principal competitors. During the post-war period, however, owners of new industrial establishments are said to have come to look upon a public service of electric power as the first and obvious means of supplying their power requirements. In most parts of the country, the authors contend, public electricity supply has been developed to a point at which new industries automatically purchase their electric power and the advantages of this practice are likely to increase in the future.

The negotiation of contracts for the public supply of electricity to large power users is stated to be one of the most difficult and complex tasks of the supply engineer. Until recently industrialists who have been educated to measure electricity in terms of kilowatt-hours have been reluctant to purchase their supplies under contracts providing for a two-part tariff, consisting of a charge per kilowatt of maximum demand designed to cover the capital charges and other fixed costs, and a relatively low running charge per kilowatt-hour to cover the cost of fuel and other items which vary with the output of a generating station. In most cases, the paper explains, industrialists have failed to appreciate that the cost of providing an electric service is necessarily of a two-part nature, and that the average cost per kilowatt-hour varies widely with the hours of use; in other words, with the load factor at which the supply is taken or produced. But during recent years there has been a growing realisation by the industrial consumer of the necessity and equity of some form of two-part tariff, and, in general, large-scale industrial power supplies are charged for in this system.

The second and last paper read on Thursday, June 6th, is entitled "Domestic Electrical Development." It is divided into three sections. For Section I Miss C. Haslett, of the Electrical Association for Women, is responsible; for Section II, Mr. T. E. Alger, of the Electrical Contractors' Association; and for Section III Messrs. W. N. C. Clinch and C. B. Nadaud, the former representing the Incorporated Municipal Electrical Association and the latter the power companies. To those whose business it is to find ways and means of developing the domestic load, the paper should prove of great value, but for lack of space we find ourselves unable to consider it in all its aspects. To ensure that the rising generation shall be electrically minded, Miss Haslett advocates that schools that have domestic science departments should have good electrical equipment, such as cooking and laundry apparatus, and cleaning appliances in order that children may acquire practical knowledge and experience of their use. It is also suggested that a national proving house should be set up so that the consumer may be sure that what he or she is buying is safe. In the third part of the paper Messrs. Clinch and Nadaud stress the importance of a National Electrical Exhibition, and refer to Mr. V. Dale's paper given recently at the Electricity Supply Sales Management Conference, in which he asserts that the country is more ready for a Wembley Exhibition than it was in 1924, and contends that a National Electrical Exhibition would appeal vastly to the imagination of the public, and could be organised on commercially successful lines.

After presenting the paper on "Industrial Power Supply," Mr. Hobson referred to the question of the disposal of plant displaced by the grid. There were coming on to the market a certain number of machines and a certain number of boilers whose life had not yet been exhausted, and there was a tendency for the owners of those plants to sell them to the highest bidder and for these plants to find their way into industrial works. By that process an entirely artificial competition was set up with the public supply industry, and looking at the business as a whole, it was a very short-sighted policy on the part of the owners of such plants. Therefore he suggested the possibility of forming some fund or pool for the purpose of buying up plants of that kind at a reasonable price and destroying them in the same way that the Central Board had destroyed plants taken out under the frequency change programme.

In opening the discussion, Mr. W. Fennell (Mid-Cheshire Electricity Supply Company) said that, judging from what the paper said about grid supplies, the distributors ought to be sweeping away the millions of horse-power which were still being operated from independent engines, but the question could well be asked why this was not being done as fast as might be expected. Personally, he believed it was largely due to the refusal of the works owner to understand the two-part tariff, and he himself had recently had an instance in which a proposed consumer definitely refused, under any circumstances, to buy under a two-part tariff. If he stuck to his guns in that case he feared that an oil engine plant would go in. Incidentally, Mr. Fennell commented on the absence from the paper of any reference to the oil engine, and emphasised the point that it was not so much steam plants that had to be competed with as oil plants. Certainly, in three out of four cases oil competition would be encountered, and he asked Mr. Hobson's views on how to deal with it. A factor in that connection was that whereas the cost of power generated by oil engines was uniform throughout the country, the cost of power purchased from the Central Board was not uniform throughout the country, and that immediately placed the electricity distributor under a serious disability. It was generally agreed that it was difficult for public supply to compete with oil engine plants between 60 h.p. and 300 or 400 h.p. There were cases, such as North Wales, where, by the time the current reached the consumer, the price was double the grid tariff price, and at such prices a great deal of business would be lost to oil engine and other competition. Therefore the Board should reconsider its position and, if necessary, obtain powers from Parliament to unify its prices throughout its area just as the Board was urging the local distributors to unify their prices in their areas.

Mr. J. W. J. Townley (West Ham) drew attention to the difficulty experienced in dealing with large industrial combines who have works in various parts of the country for which a power supply is required. Concessions in the matter of price in a large industrial area, for example, were used as a lever to obtain similar concessions in another area where the conditions were quite different. Moreover, it was often found that one firm asked for a supply and sent a certain gentleman to negotiate the contract. Then another firm in the same district, working perhaps under quite different conditions, applied, and the same gentleman came along to negotiate the contract and asked for similar terms. The point was that in the case of these large combines controlling many businesses the power contracts were reviewed by a central engineering department and a central accountants department, and that created considerable difficulties in negotiating contracts. The more he considered this problem of power supplies and the granting of very low rates, the more he was convinced that half the troubles of the supply industry were caused by those in the industry. One undertaking did something in cutting rates which had a repercussion upon its neighbours for the reason he had mentioned, and even though they might know what municipalities were doing they knew very little about what the companies were doing. He therefore suggested that some means should be found for ascertaining what the various supply authorities were doing as regards charges for power and the conditions in which the supply was taken. Could not some central body be established for the collection of information of this nature, so that undertakings might not be forced unwittingly into offering rates, in order to get the business, which showed very little margin of profit? Perhaps the most suitable body for this would be the Electrical Development Association in conjunction with the Central Electricity Board.

Mr. J. N. Waite (Hull) expressed the view that one of the grave defects of the Electricity Supply Act of 1926—although the Central Board was not to be blamed for that—was that under Section 13 the selected stations had a guarantee which the non-selected stations did not have, viz., that grid current should not cost more than current could be generated by the particular station, and the effect of the absence of that guarantee in the case of non-selected stations had been particularly evident in the case of North Wales. He believed the Central Board recognised this, and it was to be hoped that steps would be taken to put the position right. The logical development of the 1926 Act was the pooling of generation facilities and a tariff to all undertakers based on quantity and adjusted for load factor. That would have to come eventually even if it be in the far distant future. Speaking of getting all possible business in order to obtain the full benefit of the grid scheme, Mr. Waite said that in Hull he was supplying 90 per cent. of the total available power, and was well on the way to getting the remainder. One of the difficulties, however, had been to try and negotiate a power contract on a fixed tariff. There must be some flexibility.

Mr. D. E. Kidner (Barking) mentioned that a certain works at Dagenham, which had installed a coke oven plant and produced a tremendous amount of waste gas, did not use that gas for process purposes, but actually sent it through his district and sold it to the Gas Light and Coke Company to sell again in competition with electricity. That seemed to be a bad thing for the industry, and ought, in some way, to be prevented. Speaking of wood-working factories, of which there are a number in Barking, Mr. Kidner said there were large quantities of wood waste which the factory owners would be very pleased to get rid of cheaply. As they could not do so, they used it for gas production, which enabled them to produce very cheap electrical units, because the fuel cost them nothing. Nevertheless, in Barking there was some 85 per cent. of the available industrial load on the public mains, and recently he had quoted a tariff of 19s. 6d. per kVA and 0·37d. per unit for an electric furnace plant which he hoped would have a 90 per cent. load factor.

Mr. R. P. Sloan (North-Eastern Electric Supply Company), speaking on the question of substituting privately generated supply by public supply, said that during the past four years he had replaced 56,000 h.p., and many thousands of horse-power had been displaced in previous years. The problem of the disposal of the displaced plant, however, was a difficult one, because if it were sold and re-erected in the area, the position was not much improved from the competition point of view. Therefore, he favoured some scheme, as suggested by Mr. Hobson, of preventing this sort of thing happening. He usually took care to see that such plants were not used by another owner in his own area, but when it went into a neighbouring area the industry as a whole was being injured. Therefore some means should be found for putting such plants out of use altogether. Commenting on the demand so insistently made for reduced costs, Mr. Sloan said that whilst generally he was in favour of low prices to the public, he felt that the industry was overdoing it in the matter of low prices for domestic purposes. In his area 90 per cent. of the total load was industrial, and therefore the position was not so serious, but the tendency constantly to reduce the charges for domestic supplies should be stopped, because in other areas where the proportion of the industrial load was not so large as in his own, this reduction in price for domestic supplies meant a less margin with which to fight against private industrial plants and bring them on to the public supply.

Alderman W. Walker (Manchester) remarked that

there had been such a great concentration in recent years upon the domestic load that in some cases there had been a failure to get hold of the industrial load, which, after all, must be the backbone of the electricity supply industry. The development of the industrial load not only meant a greater demand for electricity, but the paying of more wages and the increase of the spending power of the people, and that was important. The tables in the paper were some of the finest he had ever seen in this connection, and their value in making possible a comparison between a private plant and public supply was inestimable.

Councillor E. Kennedy (Scunthorpe) said that in his area not 4 per cent. of the load was industrial, and the turnover of 5 million units was practically all domestic. The area was surrounded by some of the most progressive industries and modernised plants in the country having a load of over 200 million units per annum. The Scunthorpe undertaking was started in 1924, and at first took a bulk supply from a steel works. When that agreement came to an end, it was found that the grid prices were nothing like so favourable as the old prices, and therefore what chance had the undertaking of getting the large works on to its mains? Indeed, one firm was now installing a 5000-kW plant and another a 3000-kW plant, whilst during the past five years some 6000 kW of plant had been installed in private works. Last week a power company offered to buy up the Scunthorpe undertaking, and having regard to the optimism of many of the speeches at the Convention, he felt that places like Scunthorpe should be assisted to prevent these large private plants being installed. Private power plants in North Lincolnshire were valued at something like £30,000,000, and there was evidently a field there. If something was done at this Convention to help Scunthorpe to solve this problem, he would be infinitely obliged.

Bailie A. Munro (Glasgow) said that in Scotland the electricity supply authorities were in the hands of an unscrupulous band of coal merchants! Three years ago the cost in Glasgow was 10s. 3d. per ton of washed nuts; that year the load went up by 20 per cent., and the coal merchants increased the price of coal to 12s. 9d. per ton; whilst since then the price had been increased to 14s. per ton, a total increase of 3s. 9d. per ton. If the coal merchants were not prepared to give supply undertakings a fair deal, then the coal mines ought to be nationalised, because it was no use engineers having all their efforts to reduce costs nullified in this way. If the present state of affairs was allowed to continue, there would be no prospect of further reductions in the charges for electricity to the public.

Captain J. M. Donaldson (North Metropolitan Electric Power Company) said his experience of owners of private plants was that they forgot they had capital charges to meet on their plants, and either assumed that their plants had been given to them—which, after what Sir Felix Pole had said on the previous day seemed not unlikely—or that they had stolen their plants, which was not altogether probable. Nevertheless, this was a difficult aspect of this particular problem. Whilst willing to accept the suggestion in the paper that the capital charges assumed for a private plant should be on the basis of the return on the money invested in the business this raised an awkward point, because if the business was showing no profit, then the capital charges, so far as interest was concerned, disappeared, and on the face of it he did not know the answer. Speaking of tariffs, Captain Donaldson said he did not agree with applying the two-part tariff to the industrial consumer. It was, of course, necessary to treat consumers taking the supply under the same conditions on a similar basis, otherwise there was likely to be considerable trouble, but the two-part tariff in itself was not satisfactory. It represented the true Hopkinsonian idea, but it was ridiculous to say that a consumer with a maximum demand of 20 kW should get the same price as the consumer with a maximum demand of 20,000 kW. Therefore, he had a tariff which was variable in the sense that the kW demand charge varied slightly with the demand, because with the bigger demand the substation costs were less. The difference between the smallest and the highest was about 15 per cent., and all the units were taken on the block system, a small block of units being charged at a relatively high price, and the price going down rapidly with the increase in the number of units. In addition, when the demand was off the peak, only 20 per cent. of the fixed charge was made, and in this way most of the problems which arose were covered. A standard printed agreement existed, and he consistently refused to alter the terms, although he was often rung up by a manufacturer and asked to do so.

Mr. Hobson, replying to the discussion, agreed that the resistance on the part of industrial consumers to the two-part tariff in certain industries is serious in spite of the educational process that had been going on, and he mentioned flour milling as a case in point. In such cases it was necessary to meet the views of the consumers by offering a flat rate tariff or some form of graded tariff. That, however, should not entail any undue business risk on the part of the supply authorities. The Central Board clearly could not adopt such a policy in dealing with its consumers, because it was under statutory liability to produce a grid tariff under which anybody could take a supply. Thus, the Board's tariff must cater for very widely differing classes of consumers, and also consumers whose conditions might vary very widely. For instance, he remembered an inquiry for a bulk supply by a new undertaking in an entirely rural area, and the estimates were for a load growing to 200 or 300 kW in the course of five years. Within three months of starting, however, large cement works were erected in the area, and the likely demand immediately rose to 2000 or 3000 kW at a very much higher load factor. The Board's tariff, however, could not be altered, and it had been designed to meet such varying conditions. The individual supply authority, on the other hand, with experience of the conditions in its own area, was able to adjust its tariff to meet special cases without running undue risks.

Reference had been made to the necessity for the Board providing a connection to every undertaking in the country, and that would be a desirable ideal, but it had to be remembered that the Act of 1926 was passed in 1926 and not in 1882, and that the Board had to superimpose the grid on an existing structure which included a number of large power companies who had spent large sums on transmission mains and were already giving bulk supplies to a number of authorised undertakers. Therefore, it was not possible for Parliament to go the whole hog at one step and cut out all the existing arrangements. The development of the grid must be slow from that point of view. Possibly, however, at the end of the first decade which had been budgeted for it would be possible to review some of the anomalies that had been mentioned, but he did not think that was possible at the moment. It was true that large industrial combines were springing up all over the country and were seeking consessions in the various areas in which their works were situated. In an unofficial way the Central Board had been supplying information to assist engineers in the manner suggested by Mr. Townley. On the question of power charges, Mr. Hobson contended that for the ordinary run of power business it is essential to have standard rates with, perhaps, some grading by way of discounts to give an advantage to the larger consumer. Nevertheless, there was, outside that range of business, a great deal of high load factor business for which special contracts would have to be negotiated. Replying to Mr. Waite and the alleged absence of protection for the non-selected station under Section 13 of the Act of 1926, Mr. Hobson said that the owners of such stations could not have their stations closed down unless it could be shown that the grid price was actually lower than their works costs, and, moreover, they could not be forced to buy even a partial supply of grid current unless the Commissioners were satisfied under Section 11 of the Act of 1919 that to do so would be better than an extension of the station.

The position in Scunthorpe was a difficult one and seemed to call for some kind of amalgamation or redistribution of area. The nationalisation of the coal industry was rather beyond the powers of the Central Electricity Board, although Bailie Munro had hinted at it.

Mr. H. C. Lamb (Manchester), proposing a vote of thanks to the authors referred to the tendency to increase the price of coal to public utility undertakings, and urged the industry to watch this important development having regard to the manner in which it had been handicapped by the De-rating Act. Some of the leaders of the coal industry had mentioned fantastic prices which they thought public utility undertakings should pay, and an order had been deposited in Parliament, one of the objects of which was clearly to discriminate against these undertakings. Therefore, every possible pressure should be brought to bear to prevent this discrimination.

In dealing with the suggestions in the paper on "Domestic Electrical Development" concerning the establishment of a proving house, Mr. C. Clifford Patterson said that the problem was not so difficult of solution as some might think. By the term "proving house" was clearly meant the establishment of a national standard of permanent safety for all electrical household apparatus which denoted some form of national mark. At the same time, in adopting such a plan it was necessary to go far beyond merely sending in selected test pieces for certification, and for all such apparatus of that class then to be sent out with a mark. What was necessary was that manufacturers should have to obtain a licence to use a mark in respect of any class of apparatus, which, in turn, should carry with it the submission of his manufacturing controls or his factory processes, if necessary, for approval after inspection. Otherwise, there would be no guarantee that the apparatus complied with any specification upon which the granting of a licence to use a mark might be founded. In the meantime, it was not generally realised that the manufacturers of electrical apparatus in this country at the present time were themselves taking every possible step to ensure safety, not only by working according to British Standard Specifications, but also by taking other measures, and if these efforts had not been advertised it was simply because the manufacturers were trying to get this scheme completely into working order and gathering experience slowly and soundly. Such a scheme as he had outlined, continued Mr. Paterson, would, of course, involve establishments where apparatus could be independently tested, but such testing laboratories were easy to visualise and were not a difficult part of the whole scheme. He therefore expressed the hope that the machinery which existed at the present time, in the manner he had indicated, for ensuring standards of safety, should be carefully considered by the electrical industry, and he suggested that one *sine qua non* of the use of a mark must be the acceptance of a standard safety specification.

Councillor H. Coates (Watford), commenting on the figure of 500 units per head per annum, which was contemplated by the Electricity Commissioners, said that in his own house with seven in family, the consumption was over 3000 units per head. In Watford, when they endeavoured to open a showroom, there was immediate opposition on the part of the local contractors, and that feeling must be done away with. Municipal electricity supply authorities must have showrooms, and the whole success of the fair trading policy depended upon the honourable fulfilment of the obligations and agreements entered into between the supply authorities and the contractors. Therefore he urged the contractors to co-operate with the supply authorities more than was frequently the case at the present time.

Mr. W. C. Parker (Fulham), pleading for simplicity in tariffs, said that the full development of the use of electricity would not be achieved until the average person really understood what he was paying for, and how much it was going to cost, especially having regard to the fact that 70 per cent. of the population had incomes of probably under £3 per week. There were three things in selling electricity which had to be overcome. The first was cost, and the average person to-day still felt that electricity was costly. Therefore it was essential to avoid complications in tariffs. Secondly, there was fear on the part of many people in using electricity; and thirdly, there was a considerable amount of apathy to be overcome among people who were using other forms of heating and cooking, and were not prepared to try any new method.

Mr. E. G. Batt (General Electric Company) said that whilst manufacturers were naturally in favour of standardisation, the point to be considered was that it was no use spending time, money, brains, and energy in drawing up standard specifications if they were not going to be universally adopted. Notwithstanding all that had been done with standardisation, his own firm had no fewer than forty-two different types of cooker going through their shops, and another member of B.E.A.M.A. had no fewer than seventy different types of cooker control units. The sort of thing that was happening was that even members of a committee dealing with a standard specification had gone home to their respective areas and ordered goods which were not standard. Another difficulty was the prevalent tendency for buyers to look mainly if not solely at the question of price when ordering. The leading manufacturers in this country were spending thousands of pounds individually and collectively upon research, and therefore he suggested that these companies were entitled to special consideration by the industry when orders were being placed, and that orders should not be given to the makers who offered goods at the lowest price and contributed nothing either by way of praise or money to research and development, but merely eat their way into the business by cutting prices.

Mr. F. W. Purse, urging the need for a two-part tariff, contended that the present numerous methods of charging were absolutely unnecessary, because they were all only an average in the end, and the industry should not delude itself into thinking that all its tariffs were scientifically and absolutely correct. If therefore the Central Electricity Board had been able to apply a two-part tariff to its very large area, it was surely possible to apply two-part tariffs to the smaller areas of the authorised distributors. At the same time, a two-part tariff all over the country must not be confused with a uniform price. If, however, a uniform basis of charge by way of a two-part tariff could be established for the whole country, we should at any rate remove one reproach to the existence of 600 supply undertakings.

Mrs. G. E. Green dealt with the problem of hot water supply in small houses where a constant supply of hot water was too expensive, no matter what method of heating was adopted. Therefore she suggested putting in a storage tank with a capacity for one bath at a time, with a hand switch control and a loading of 3 kW or 4 kW. Such a tank need not be lagged, as the length of pipe would be comparatively short, and by this means it would be possible to obtain a small hot bath for a consumption of 3 units of electricity. Where a wash boiler was also installed, a switch could be arranged so that both pieces of apparatus could not be used at the same time. If there was no wash boiler, then the water heater and the cooker might be interconnected. Another method was to have a larger capacity lagged tank, so arranged that the electricity was taken at off-peak periods.

Mr. F. J. Pearce (G. H. Scholes and Co., Ltd.) said that whilst all manufacturers were generally in favour of standardisation and interchangeability this should not be applied to apparatus that was not yet perfected. For instance, plugs and sockets were a

long way from being perfect, and there was no doubt that manufacturers would be able to provide something better in the near future. Developments of that nature were taking place at the present time.

Councillor Mrs. Gregory (West Ham) said there are still many densely populated areas where supply is not available to the domestic consumers at prices which will allow the full use of electricity. The possibilities of profitable supply to the low wage earning class had been shown in West Ham where before the 1d. all-in rate was introduced in 1933, there were only 850 cookers in use. As a result of the introduction of that rate, however, the number of cookers to-day was 6500, and 80 cooker agreements had been signed during the week before the Convention. The average consumption was just over 1400 units per consumer per annum, and she recommended this system of charging to engineers in other areas having to deal with similar conditions to those in West Ham.

Councillor Mrs. J. Roberts (Glasgow), after expressing the hope that electrical engineers would "get down from their pedestals" and deal with electrical matters in a simple manner to the non-technical person, referred to the portion of the paper by Mr. Alger and the comments in it as to unfair competition from municipalities. She suggested, however, that probably the greatest quarter from which unfair competition was being experienced by the contractors was among themselves, and the contracting part of the industry should endeavour to put its own house in order. In Glasgow, there were all kinds of pettifogging electrical contractors canvassing for installation work, and putting in cheap jobs, using foreign material and apprentice labour.

Alderman J. R. Potts (Carlisle) spoke of the dissatisfaction in rural areas, because no supply could be obtained, notwithstanding the Central Board's lines passed through the district. He knew the difficulties, but urged that some steps should be taken to expedite supplies in these rural areas. He also suggested that one of the biggest hindrances to the development of electrical progress has been due to the municipalities themselves, who, although embarking upon large housing programmes, and building in the aggregate something like 3,000,000 houses, had wired very few of them for anything else than lighting; 70 per cent. of them had not a plug of any description.

Mr. Clinch, who replied on behalf of all the authors, and remarked that they were all living in completely electrically equipped homes, said that as regards standardisation, nothing should be done which would interfere with progress, and the authors had not asked that this should be so. What they had demanded was that all apparatus selected should be of suitable quality and construction, but the authors also contended that without statutory powers it was impossible for these requirements to be fulfilled. He believed that municipalities could not be charged with buying at the lowest price, although he agreed with the criticisms of Mr. Batt in this connection. Although the electric fire might be a difficult proposition in relation to the peak load, it perhaps was not so serious as some were inclined to believe. Moreover, the paper had endeavoured to show that the diversity of the water heating load was such that it did not interfere with the station peak, and that had been the experience in quite poor class houses.

On the motion of Mr. C. H. Cox (Edison Swan Electric Company, Ltd.), a hearty vote of thanks was accorded to the authors of the paper.

At the close of the discussion the following resolution was passed:—

"That this National Electrical Convention, representing all sections of the electrical industry, heartily approves the principle of closer co-operation between various associations, and unanimously requests the constituent associations to nominate two representatives, each to serve on a committee for the purpose of exploring the matter, and that this committee be convened as soon as possible after the close of the Convention, and that this committee be empowered to co-opt not more than five additional representatives of the industry at its discretion."

At the banquet held at the Pavilion on Thursday, June 6th, Mr. E. E. Hoadley, the President, read messages from H.R.H. the Prince of Wales and Mr. Hore Belisha, regretting their inability to attend. The Minister of Transport was, however, represented by Captain A. V. M. Hudson, the new Parliamentary Secretary to the Ministry of Transport.

In proposing the toast of "The Electrical Industry," Captain Hudson said it could be claimed that the industry was one of the most important in the country, and that since the war its policy had been one of continued expansion. As evidence of this, he mentioned that the number of units sold has increased from 4998 millions in 1924 to 12,782 millions in 1934, and in the current year the monthly returns of units generated, issued by the Electricity Commissioners, showed that for the first four months there had been an increase of 10½ per cent. over the corresponding period of last year, which was, in itself, a record year. Further, whereas in 1919 there were about 750,000 consumers of electricity in Great Britain, the number at the present time was in the neighbourhood of 5,000,000, and new consumers were being connected up at the rate of between 500,000 and 600,000 per annum. It had also to be realised that a great deal of this expansion had taken place during a time of trade depression in this country and he had no hesitation in saying that the industry had definitely played a very large part in overcoming that depression. The Government believed that this Jubilee year, so strikingly chosen for holding the first National Electrical Convention, marked the end of the depression and the beginning of better times. Personally, he saw the prospect of enormous expansion in the industry in the future, and the £35,000,000 guaranteed by the Government for the development of railways, tubes, and trams in London was an indication of the trend of opinion.

The President replying to the toast said the week had been a wonderful one, and in spite of one or two setbacks which had been experienced before the Convention started, it could be acknowledged on all hands that they had accomplished at least some of the things which they had set out to accomplish. Everybody was disappointed that H.R.H. the Prince of Wales found it absolutely impossible to be present, owing to the incidence of another engagement which had to be kept; secondly, they were all disappointed that the Minister of Transport had found, at the last moment, that he was unable to attend the banquet, but everybody was pleased that his place had been taken by Captain Hudson.

Electricity Supply, 1932-33.

THE return of engineering and financial statistics relating to authorised undertakings in Great Britain for the year ending March 31st, 1933, or May 15th, 1933, for public authority undertakings, and December 31st, 1932, for company undertakings has been issued by the Electricity Commissioners. During the year 1932–33 there was a net increase of upwards of 690,000 (or nearly 15 per cent.) in the number of consumers of electricity connected to the public supply systems throughout the country, the total number of consumers at the end of the year being over 5,336,000. The total sales of electricity to consumers during the year amounted to 10,210 million units, representing an overall average of about 1913 units per consumer or 226 units per head of population in 1932. As from January 1st, 1933, the "Grid" system in the Central Scotland and Mid-East England Electricity Scheme areas was brought into commercial operation by the Central Electricity Board.

Of the total supply of electricity by authorised undertakers, about 64 per cent. was provided by public authorities and about 36 per cent. by companies, these proportions broadly applying to the aggregate capacity of the generating plant installed by the respective groups of undertakers and to sales of electrical energy to consumers.

The production of the public supply of electricity in 1932–33 involved the operation, by authorised undertakers, of as many as 451 generating stations, containing in aggregate about 7,365,000 kW of generating plant. With regard to the concentration of generating plant, nearly 80 per cent. was contained in 100 stations, each having an installed capacity of 25,000 kW or over, and just over 20 per cent. was distributed among the remaining 351 stations, of which 181 had an installed capacity of less than 1000 kW each.

The total amount of electricity generated at the public supply generating stations of authorised undertakers in 1932–33 amounted to upwards of 12,347 million units, of which 1517 million units, or 12·3 per cent., was generated under the directions of the Central Electricity Board. The output showed an increase of over 814 million units, or 7 per cent., as compared with the previous year.

The supplies given by the Central Electricity Board to authorised undertakers in 1932–33, whether under temporary arrangements pending the completion of the new Regional ("Grid") Schemes or as the result of the general trading operations which were commenced by the Central Board as from January 1st, 1933, in two of the scheme areas, as previously mentioned, amounted to 1832 million units. The bulk supplies purchased by public authority and company undertakers from one another amounted to 3221 million units.

The particulars relating to the distribution systems of public supply undertakings show that A.C. supplies of eleven different frequencies were being distributed in 1932–33, and that the declared voltages at consumers' terminals for low and medium-pressure A.C. and D.C. supplies taken collectively numbered forty-five. The latter figure includes related pairs of voltages on three-wire and four-wire systems. Further progress was made during the year with the standardisation of frequency under the Electricity (Supply) Act, 1926, in the areas of certain of the new Regional ("Grid") Schemes.

In the year 1932–33 the gross public supply, consisting of the electricity generated at the stations of authorised undertakers (whether under the directions of the Central Electricity Board or independently), together with supplies purchased from outside sources, amounted to over 12,513 million units, an increase of 823 million units, or 7 per cent. as compared with the previous year. The sales to consumers (10,210 million units) accounted for 81·6 per cent. of the gross public supply, the remaining 18·4 per cent. being accounted for by the works requirements of the undertakers themselves, and by losses in transmission and distribution, &c.

With regard to the different classes of supply, power supplies accounted for about 56 per cent., lighting, heating, and cooking supplies for 34 per cent., and traction supplies for over 8 per cent. of the total units sold to consumers. The sales of electrical energy for lighting, heating, and cooking purposes increased by 397 million units, while the sales for power purposes showed an increase of over 257 million units, as compared with the previous year.

The combined maximum load on the public supply undertakings in 1932–33 based on units generated and/or purchased, was of the order of 5,140,000 kW, and that on the generating stations of authorised undertakers was of the order of 4,156,000 kW. The capacity of the generating plant installed was 77 per cent. in excess of the combined maximum demand upon it. The load factor of the generating stations of public authorities and companies taken collectively was of the order of 33·9 per cent.

Public supply electricity undertakings were consumers of coal and coke to the extent of over 9,074,000 tons in 1932–33, this figure including over 1,206,000 tons of pulverised fuel. The average cost of the coal and coke amounted to 15s. 2½d. per ton, as compared with 15s. 9d. in 1931–32.

The average fuel consumption at the steam power stations (which were responsible for over 96 per cent. of the total number of units generated for public supply purposes) amounted to 1·72 lb. per unit generated, or practically half the quantity per unit required in 1920–21.

The total expenditure charged to capital account by all authorised undertakers, including the Central Electricity Board, amounted at the end of 1932–33 to over £436,000,000, of which 33 per cent. was in respect of generation and 67 per cent. in respect of transmission, distribution, &c. The average expenditure of the electricity supply industry for all purposes per kilowatt of generating plant installed for public supply was just over £59. The net capital expenditure during 1932–33 amounted to upwards of £35,710,000, an increase of nearly 9 per cent. on the total expenditure at the end of 1931–32.

The net total revenue of public authority and company undertakers in 1932–33 from the working of their electricity undertakings (exclusive of all sales of electricity in bulk) was £61,300,000, as compared with £58,606,000 in the previous year. The total revenue represented an average of 1·44d. per unit sold, the corresponding figure for the previous year being 1·48d. The average revenue per £100 of total capital expenditure by public authorities and companies amounted to £15·2.

The net total working expenses of public authority and company undertakers (including the cost of all energy purchased from outside sources, but excluding all inter-purchases between the undertakers and purchases from the Central Electricity Board, and also capital charges) were over £29,853,000 in 1932–33, as compared with over £29,316,000 in 1931–32. The working expenses absorbed nearly 49 per cent. of the corresponding revenue from working, as compared with 50 per cent. in the previous year.

An important item of expense was the works costs of generation, this item accounting for over 38 per cent. of the total working expenses. Of the other principal items, transmission and distribution accounted for 15 per cent., management for 19 per cent., and local rates for nearly 15 per cent. The average working expenses per £100 of total capital expenditure by public authorities and companies amounted to £7·4 in 1932–33.

For public authority and company undertakings as a whole the excess of revenue from working over working expenses, together with revenue from other sources, provided a gross surplus in 1932–33 of upwards of £33,534,000, representing about 8·3 per cent. on the total capital expenditure of public authorities and companies at the end of the year.

In the case of public authorities, the gross surplus was appropriated to the extent of 33·7 per cent. for interest charges on loans and deposits; 45·7 per cent. for loan repayments and transfers to sinking funds and to reserve and renewals funds; 5·5 per cent. for income tax; 10·8 per cent. for special expenditure, including amounts applied to capital outlay; and 2·1 per cent. in relief of local rates, the latter item representing a net contribution of about £434,000. The remainder of the gross surplus, amounting to over £423,000, represented the increase in the balances on net revenue account.

At the end of 1932–33, the capital (or loan) accounts of public authority and company undertakers were overdrawn to the extent of over £25,000,000; the balances in depreciation, reserve and renewals funds, including sinking funds in the case of public authorities, amounted to over £49,500,000; and the balances on revenue account amounted to £5,206,000.

In 1932–33 the electric supply undertakings of public authorities and companies gave direct employment to over 70,000 staff and workmen on generation, distribution, and administration, the total salaries and wages charged to revenue account amounting to £10,931,000.

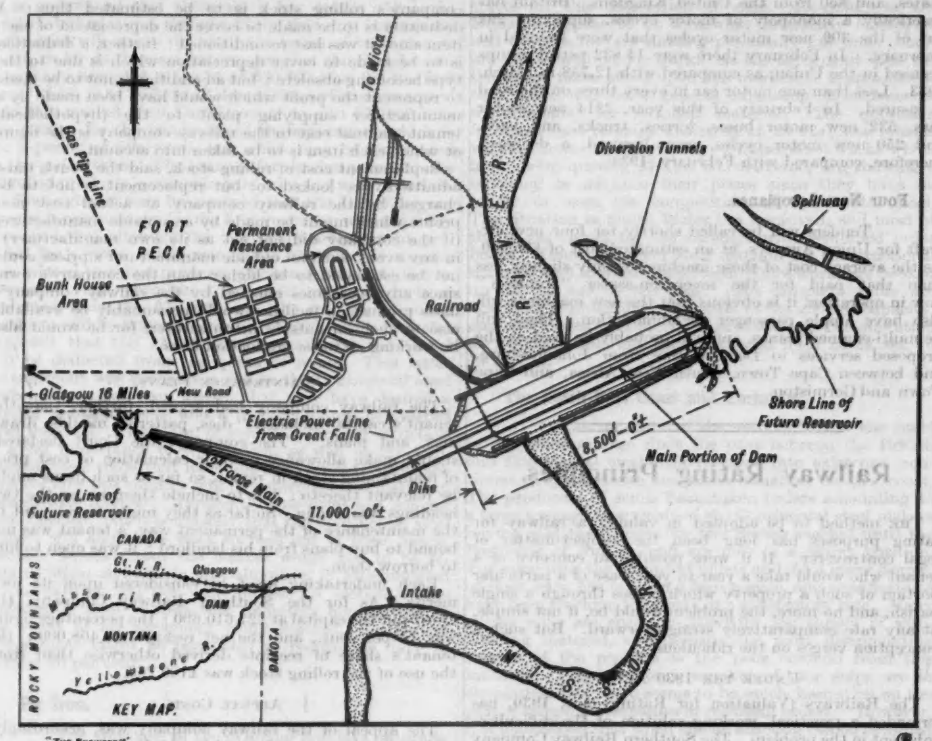
These statistics relate exclusively to authorised undertakings providing public supplies of electricity in Great Britain. To obtain a complete measure of the extent of electrical development in the county, account would also have to be taken of the supplies derived by railway and tramway authorities from their own generating stations; of the output of the large number of private generating stations established by collieries and other industrial and commercial organisations for the purposes of their respective undertakings; and of cases in which public supplies of electricity are given by undertakings established without statutory powers. These aspects of electrical development are outside the scope of the return.

THE INSTITUTE OF MARINE ENGINEERS.

BY invitation of the directors of W. H. Allen, Sons and Co., Ltd., a party of fifty members of the Institute of Marine Engineers, accompanied by representatives of the Technical Press, visited Queen's Engineering Works, Bedford, on Wednesday last, June 5th. The party, which was under the leadership of Mr. S. N. Kent, past Chairman of Council, was officially received by the directors, the administrative and the technical staff, and after luncheon an inspection of the works was made. At the close of luncheon, in the unavoidable absence of the chairman of the company, Mr. Richard W. Allen, Mr. Harold G. Allen, the deputy chairman of the company, gave a short account of the work of the firm and its recent developments, and Mr. S. N. Kent briefly replied. Considerable interest was shown in the various re-grouped modern shops and machine tools, and the large amount of marine and land work which is now going through the shops. On the steam side, one of three 500-kW turbo-generator sets and a turbine-driven circulating pump for the new Orient Line steamer "Orion," now under construction at Vickers-Armstrong's Barrow Yard, were seen, and a range of the latest Allen "C" frame design oil engines, both of the medium and high-speed types, arranged for propelling and auxiliary services, was inspected.

A Huge Earth Dam in America.

IN the United States, on the confines of Montana, where it borders on Canada, there is being built the largest earth-fill dam ever deliberately constructed by man. It is to dam the waters of the Missouri River and provide local power and irrigation services, while regulating the flow of that river, so that navigation may be maintained at times of, otherwise, low water, and that the floods of the Mississippi Valley may be mitigated. It is being constructed under the policy of the States to find work for unemployed labour and involves a scheme about five times as great as that of the Gatun Dam of the Panama Canal, the largest earth-fill dam so far made. During its construction from five to seven thousand men are being directly employed, and the results of its completion, in the way of



PLAN OF EARTH-FILL DAM ACROSS MISSOURI RIVER

employment, are hardly estimable. Apart from any other consideration an area of 180,000 acres of fertile land will be put under perennial irrigation.

The site of the dam, as will be seen from our inset in the plan of the site, is above the junction of the Missouri and Yellowstone rivers in a country which has an elevation of some 2000ft. above the sea level, with the Rocky Mountains, sources of the tributary, rivers to the west.

The dam, at Fort Peck, will produce a reservoir of some 20 million acre-feet capacity, having an area of 250,000 acres, a length up the valley of 175 miles, and a maximum width of 16 miles, with a shore line of 2500 miles. The dam itself will have a total length of about 3¼ miles, of which 8500ft. will be the dam proper, and the remainder a long curved dyke, as shown in the plan we reproduce. The maximum height above the river bed will be 242ft. and the greatest width at the base 3000ft. The width at the top is to be 100ft. For the purpose of building this huge dam it is estimated that there will be required 100 million cubic yards of earth, 1·6 million cubic yards of rock, and 4 million cubic yards of gravel.

The locality of the dam is similar to that of the Great Boulder Dam, on the Colorado, which we have fully described, in that it is desolate and practically uninhabited. So the first operation of the Government has been to provide housing for the 5000 to 7000 men employed on the work. The temporary town which has been built is connected with Glasgow, on the Great Northern Railroad, by a new road 16 miles long, and an 8in. gas pipe line. It is also linked up with the railway at Wiota, by a new line 14 miles long, and is supplied with electricity from Great Falls, about 250 miles upstream.

The earth fill is being placed by hydraulic methods, there being four big dredgers at work. They were temporarily shut down on account of the severe winter weather, with temperatures 25 deg. below zero, but started up again this spring. The dredgers have timber pontoons measuring 130ft. by 30ft., and each is equipped with two pumps driven by 2500 h.p. electric motors. These pumps discharge into a floating pipe line to a floating "booster" plant, where there are two more pumps. Finally there is another pump on a mobile land car; so that there are five pumps to each dredging unit. The dredger is capable of dredging to a depth of 50ft. below the water and has a cutter driven at a speed of about 25 r.p.m. by a 700 h.p. motor. The total suspended weight of the suction boom is about 135 tons. But before this hydraulic filling could be started some four million cubic yards of gumbo surface soil had to be stripped off and taken away to a dump two miles distant. It was also necessary to drive a sheet steel cut-off wall in the subsoil down to the solid shale. Some of these piles had to go down as far as 156ft.

Although the outdoor work was more or less suspended during the winter, the opportunity was taken to carry on some other parts of the project, such as the river diversion tunnels. These tunnels, which are at the eastern end of the dam, and must carry the flow of the river during the construction of the dam, are being bored through the shale bluffs of the river. There are to be four tunnels, each with a finished internal diameter of 26ft., which requires an excavated diameter of 32ft. They range in length from 5200ft. to 7150ft. and their construction will require the use of some 75,000 tons of steel and about 600,000 cubic yards of concrete. The total tunnel excavation will amount to about 2,750,000 cubic yards.

A pilot tunnel 16ft. in diameter is being bored along the alignment of each of these tunnels, but the material is so treacherous that the workmen have to wear metal hats, like those of wartime days. It is proposed, when the pilot tunnels have been completed, to install Sullivan machines, which have already been tried out experimentally, to cut a slot about 3in. wide round the periphery of the 32ft. bore and thus reduce overbreak. It is, however, obvious already that it will be necessary to keep the timbering very close up to the working face.

A spillway with a designed discharge of 250,000 cubic feet per second is being constructed beyond the eastern end of the dam, as a precautionary measure. It will, according to the *Earth Mover*, cost some 7,000,000 dollars, but is unlikely ever to be called into service.

The Mechanical Handling of Freight Traffic.*

INTENSIFIED study through the medium of Research Committees of the four railway groups of improved handling methods and the extended employment of mechanical equipment is resulting in the adoption of new methods by the British railways, whereby the loading, unloading, and transfer of freights at station termini may be more efficiently performed.

Many of the commodities transported by the railways do not readily lend themselves to mechanical handling, as they range from cases of grocery, bags of sugar, bales of hops, cases of glass, jars of spirits, carboys of acids, pianos, &c., to long brass and copper tubes, stoves, and fowl-houses in sections. The methods adopted for the safe handling of one class of consignment necessarily differ from those required for another.

The problem is therefore being studied with a view to discovering the most effective equipment which is sufficiently flexible to deal with the greatest volume of differing types of traffic, and opportunities are taken to test under actual working conditions all appliances the adoption of which is calculated to produce a greater measure of efficiency.

The operations at railway goods stations may be divided under four headings—sheds, yards, cartage, and warehouses. At the railway freight sheds at large towns, such as London, Birmingham, Cardiff, and Manchester, power capstans are largely used for rapidly placing wagons in convenient positions for loading and discharge, and wagon traversers, as well as truck turntables, are useful at convenient points in or adjacent to goods sheds for transferring wagons from one line to another, and for avoiding the disturbance of other wagons which are being loaded or discharged on the same line.

Delivery of the bulk of freight traffic is required by the public during the early working hours of each day, and goods for despatch, on the other hand, must be accepted for conveyance as late in the day as possible.

To cope with these peak periods in freight traffic movement mechanically operated trucks are employed, either as independent conveying units or as tractors with trailers attached, and mechanically operated bridges between shed decks have been successfully installed, together with low capacity mobile cranes, which can operate upon shed platforms and accelerate loading and unloading operations. The complete modernisation of railway goods sheds has also been undertaken where it was found that greater freedom of movement and the reorganisation of the positioning of railway and road vehicles were desirable.

The character of mechanical handling in goods yards differs greatly from the work in sheds. Full truck loads are principally dealt with, and cranes with lifting capacities up to 40 tons are employed. In recent years a number of goliath and gantry cranes, both fixed and traversing, have been converted from steam to electric power. The electric traversing crane serves three or four lines as well as cartage roads, and as many as thirty to forty wagons can be loaded or discharged by direct lift, without movement of either rail or road vehicles by this type of crane.

A more recent development in cranage equipment is the mobile type of power road crane of 1 to 6 tons capacity which has been introduced. The 6-ton type is largely the outcome of the introduction of containers, and is designed to deal with them. This appliance gives freedom of movement in cartage strength and accelerates the unloading of wagons which would otherwise have to be drawn into position; the retention of shunting locomotives is unnecessary and the standing time of both rail and road vehicles is reduced to a minimum.

Another modern feature is the shunting tractor, a petrol-driven, four-wheeled road vehicle fitted with buffer plates, which is employed for the movement of wagons from one point to another in a goods yard, and being equipped with pneumatic balloon tires, can travel transversely across the railway tracks. Power-operated traversers are also employed for marshalling purposes.

The cartage phase of railway operations involves use of the public roads, and in London and the larger provincial cities "mechanical horse" units of various types with trailers are proving so successful that there are now more than 1600 of these tractors in use, with an even greater number of trailers. Motor lorries are also employed on a large scale and their utility is further enhanced by fitting demountable bodies which enable consignments to be loaded at traders' works and warehouses over an extended time, whilst the motor vehicle is in the meantime available for other work.

Apart from the standard types of motor lorries, the railways also employ motor vehicles of high capacity, together with a great variety of jacks and other tackle to handle heavy machinery, electrical transformers, and other large or unusual loads.

Recently, side and end tipping motor vehicles have been introduced to transport bulk traffics, such as roadstone, tarmacadam, gravel, &c., loading being performed by hoppers or chutes and unloading by side or end tipping the whole body of the vehicle.

The warehousing facilities provided by the British railways are more extensive than those of the railways of any other country in the world, and the accommodation which has been provided at considerable capital expenditure exists at most of the principal cities in the form of three, four, and five-storey buildings, each floor of which is equipped with mechanical appliances for raising and lowering commodities stored for long or short periods.

During recent years bulk distribution has been extensively adopted by many of the more important manufacturers who desire to distribute their goods to their customers and at the same time retain control throughout the transaction. To meet these requirements, space is reserved in the large railway warehouses for the accommodation of bulk stocks, from which the manufacturers, distributors or the railway staffs, acting upon orders given, can make issues to customers within the shortest possible time. Hoists, elevators, chutes, jack tracks, and other specialised appliances suitable for the needs of each particular business are used in these circumstances to meet requirements, and the fullest possible service and advice is given by the railway staffs, who regard the conduct of such business as requiring the strictest confidence.

* Issued by a Committee of the four railway companies.

South African Engineering Notes.

(By our South African Correspondent.)

CAPE TOWN, May 15th, 1935.

Ammunition, Guns, and Aeroplanes.

INCLUDED in the Estimates of Expenditure from loan funds during the year ending March 31st, 1936, is the provision of £154,000 for an ammunition factory at Roberts Heights, Pretoria, of which £50,000 will be spent this year. In reply to questions the Minister of Defence said that it was the intention to produce at the start 0·303 cartridges—made with cordite and not nitro-glycerine—which were the type commonly in use. Later, they hoped to produce shells with the exception of detonators. He was also, he said, investigating the possibility of making rifles, machine guns, trench mortars, and trench mortar ammunition. The material for the manufacture of these munitions would be supplied by the Iron and Steel Works at Pretoria. The Government is seriously considering the possibility of building aircraft engines. Asked as to aeroplane manufacture, the Minister stated that Government would build aeroplanes on a small scale, not more than a dozen a year, which could be extended if necessary. Negotiations, he said, were proceeding with several motor car companies as to the manufacture of motor vehicles. The Government itself will not take up the manufacture. Its idea is to get a car, whether American, English, Italian, or any other make, with an established name. To build its own lorries would entail the Government placing a protective duty on imported motor vehicles that the public would never accept. In furtherance of its policy, the Government is prepared to encourage the manufacture of motor machinery in South Africa by overseas firms, partly by protection and partly by Government orders. The Ford Company is in negotiation with the Government with regard to the manufacture of parts of petrol engines for use in motor cars and lorries, and it is understood that even more ambitious ideas are being examined. The material would be obtained from the Pretoria Iron and Steel Works.

Large Railway Capital Expenditure.

The railway estimates of expenditure on capital and betterment works during the 1935–36 financial year,

which have been tabled in Parliament, reveal that a total of £4,666,143 is to be spent, or £2,193,519 above last year. The principal items are: New work on open lines, £3,512,318; rolling stock, £113,659; construction of railways, £90,760; harbours, £545,150; road motor services, £87,200; airways, £77,000.

Pretoria Ironworks.

A Bill entitled the Iron and Steel Industry Amendment Bill has passed all stages, and will have an easy passage to the Statute Book. It enables the Pretoria Iron and Steel Works to obtain another £1,500,000 capital, increasing the total to £7,000,000. The additional amount is required to enable improvements, extensions, and equipment to be proceeded with. The Minister of Industries stated that the works had shown a small profit in the last few months. The Government were putting the Bill through to provide the money if the public did not subscribe. The Minister stated that over a broken period last year the actual production of the works was 65,000 tons of highly specialised steel. The capacity of the plant was 170,000 tons a year at present, with the additional works it would be 220,000 tons. Senator Visser, speaking on the Bill, visualised a day when Pretoria would be as big a producer as Sheffield. Industrialists, however, are, in general, somewhat doubtful of the wisdom of the policy of rapidly and largely increasing the capacity of the works to meet an abnormal and temporary demand from the Witwatersrand gold mines, and want to know what is going to happen when the demand for steel material, &c., to equip the new mines now being developed, ceases, as it is bound to do.

Union Mines' Expenditure.

The expenditure of the whole South African mining industry in 1934 on wages and stores can be tabulated as follows (1933 figures in brackets):—Wages and salaries, £22,180,709 (£19,525,331); stores, £23,496,610 (£19,771,986); totals, £45,677,319 (£39,297,317). This is an increase of £6,380,002. The estimated value of the production of all mines, including diamond mines, during 1934, was £77,530,118. The total expenditure on stores and wages amounted, therefore, to 59 per cent. of the estimated value of the production.

The Rhodesian Mineral Output.

The total output of gold and other metals and minerals from Southern Rhodesia for the month of February, 1935, amounted to £467,623, compared with £496,323 for the previous month. Of this gold accounted for £385,468, coal £25,832, chrome ore £11,883. The production of Northern Rhodesia totalled £443,347, of which copper accounted for £372,399, zinc £19,497, vanadium £17,111, and cobalt £34,230.

Petrol Production in September.

It is stated by Mr. Robert Stelling, the chief engineer of the South African Torbanite Mining and Refining Company, Ltd., and also of the British-Burmah Petroleum Company, Ltd., which has a considerable share holding in the South African concern, that the production stage will be reached in September of this year, and that the initial production will be 250,000 gallons of petrol a month, rising to double that amount when the mines are fully developed. Work is going on equally rapidly at the refinery at Boksburg and at the high-pressure distillation plant at Ermelo. When the torbanite mines are sufficiently developed, so that the refinery and distillery will be producing petrol purely from indigenous products, the importation of crude oil from Venezuela will cease. Mr. Stelling has declined to say anything about the probable price of the petrol. The policy of the company is to employ South African youths and to train them in the technicalities of the work. Preference will be given to youths with a university or technical college training, who have graduated in subjects bearing on the extraction of mineral oils.

Alcohol from Maize.

A company has just been formed with a capital of £200,000 to erect a factory at Germiston, near Johannesburg, to manufacture alcohol, dry ice, and liquid carbon dioxide, cattle feed maize, oil, yeast, malt extract, glycerine, and other substances. The site is one of 9½ acres, and will be capable of handling a minimum of 130,000 bags of maize per annum for a start.

Union Manganese Deposits.

The Union Government regards the development of the Union's manganese deposits as of such importance that it has taken the unusual step of guaranteeing possible losses on the extension of the Postmasberg line to Gloucester to the amount of £4000 annually for fifteen years. Until now the Union has been losing the advantage which its manganese, which is of the highest quality in the world, should give it owing to the greatly increased world demand and improved prices. The line, which will be 23 miles in length, will cost about £120,000, and will probably take about six months to construct. Once the line is complete it is anticipated that the output from the mines will be half a million tons a year, all of which will pass through Durban for shipment overseas. This will mean considerable revenue for Durban harbour, as it will require the equivalent of one hundred ships per year to transport the ore to Europe and elsewhere.

Imports of Motor Cars.

Last year the Union imported nearly 40,000 motor cars, creating a record. The return of the Union to prosperity and a much larger spending power is, of course, responsible for this big increase, being double the imports in 1933. American cars have benefited considerably as a result, for South Africans, no longer obliged to study economy so closely as in the days of depression, are again indulging their love for big cars with great power, and as a result the sales of British cars are suffering, their smaller size and lesser horse-power handicapping them. The fact that they are more economical and, according to many owners, longer lasting, is disregarded by the majority of buyers in this country. In the past, when money was plentiful, the ambition of many was to own bigger and more powerful cars than their neighbours, and there is no doubt that this competition has again started and owners will be selling their cars after a couple of years or so, and often in less time, in order to be the possessors of the latest models. Of course, purchase on the hire system is very general, but even so, it is difficult to see how many people manage to become owners, seeing that only 71,125 persons pay income tax (starting at incomes of £400 per annum), and there were 153,000 motor cars in the Union at the end of last year, while, after the scrapping of old cars, which is constantly going on, there are to-day 184,555 motor cars on the roads. In 1927 the number of motor cars licensed was only 96,019. In the month of February, 1934, 3885 new motor cars were licensed, 779 new motor buses, lorries, trucks, and vans; 2488 of the motor cars came from the United States, and 850 from the United Kingdom. Britain has practically a monopoly of motor cycles, supplying 292 out of the 309 new motor cycles that were licensed in February. In February there were 14,832 petrol pumps licensed in the Union, as compared with 12,758 in March, 1933. Less than one motor car in every three on the road is insured. In February of this year, 2214 new motor cars, 532 new motor buses, lorries, trucks, and vans, and 250 new motor cycles, were licensed, a decrease, therefore, compared with February, 1934.

Four New Aeroplanes.

Tenders will be called shortly for four new aircraft for Union Airways, at an estimated cost of £75,000. As the average cost of these machines is only slightly less than that paid for the seventeen-seater "Junkers" now in operation, it is obvious that the new machines will also have ample passenger accommodation. They will be multi-engined planes, and will probably be used on the proposed services to Delagoa Bay from Johannesburg, and between Cape Town, South-West Africa, and Cape Town and Germiston.

Railway Rating Principles.

THE method to be adopted in valuing a railway for rating purposes has long been the subject-matter of legal controversy. If it were possible to conceive of a tenant who would take a year-to-year lease of a particular portion of such a property which passes through a single parish, and no more, the problem would be, if not simple, at any rate comparatively straightforward. But such a conception verges on the ridiculous.

UNDER THE 1930 ACT.

The Railways (Valuation for Rating) Act, 1930, has provided a practical, working solution of the difficulties inherent in the problem. The Southern Railway Company has recently had an appeal under the Act determined, after a hearing extending over sixteen days; the principles enunciated in that decision are of wide significance.

Under the 1930 Act it is essential to arrive at a figure representing the net annual value of a railway as a whole, and thereafter to seek to assess a figure which shall represent the value for the portion which lies in a particular rating area. This value, declares the statute (in Sec. 4), is found by deducting working expenses and receipts not attributable to the railway hereditaments from the total revenue. The net receipts must then be apportioned, so as to assess the net annual value; in order to do this, a hypothetical tenant must be assumed who pays rent to a hypothetical landlord, and "a just and fair division" having regard to all material circumstances must be made. The net annual value of the system as a whole must then be apportioned as between the various rating areas affected (Sec. 13); an estimate of the traffic conveyed is an important factor. "The Railway Assessment Authority" was set up to deal with railways carried on solely in England, and with regard to railways carried on both in England and Scotland, it is to act in conjunction with "The Joint Authority" to deal with such parts as are carried on in England (Sec. 5). The Assessment Authority must prepare a "Railway Valuation Roll," and before such Roll is completed, representations (comparable to objections under the Rating and Valuation Acts applicable generally) may be made; the "Railway and Canal Commissioners" are to hear appeals from decisions promulgated after such representations have been made; the various local authorities may, accordingly, take two opportunities of safeguarding their several interests, viz., by making representations and by appealing (Sec. 9). The completed "Valuation Roll" becomes embodied in the ordinary "Valuation Lists" (Sec. 12); the first "Valuation Roll" operates for five years from April, 1931, after which a quinquennial revision is to be undertaken (Sec. 3 and 11).

SOUTHERN RAILWAY COMPANY.

In this appeal by the Southern Railway Company, heard before the Railway and Canal Commission Court, the respondents (who entered cross-appeals) were the Croydon Corporation, the Middlesex Valuation Committee, the London County Council, and the Brighton Corporation. The Railway Assessment Authority had put the assessment of the railway (for 1931) at £2,180,000, whilst the Southern Railway Company contended that it should be £500,000; the appellant local authorities, however, argued that it ought to be £3,000,000; there appears to have been room for vast divergence of expert opinion, since the decision of the Court just promulgated puts the figure at £1,077,131.

PROFITS BASIS.

In arriving at this decision the Court approved the established method of arriving at assessment known as the "profits basis," to be utilised but modified, subject to the requirements imposed by the Act of 1930. That method involves the ascertainment of the following factors:

(A) Estimated capital value of the plant and implements required by the (hypothetical) tenant.

(B) Estimated remuneration to be allowed to the tenant, calculated as a percentage on his capital.

(C) The net receipts of the undertaking.

A is then divided by B, and the resulting figure is subtracted from C. The figure so finally resulting is to be deemed to be the net annual value of the railway undertaking.

Both the Railway Assessment Authority and the appellant local authorities contended that the 1930 Act has rendered the "profits basis" method of calculation obsolete, whilst the railway company itself contended for its preservation, subject to the tribunal not considering itself bound to apply rules which have become stereotyped through the established practices of rating surveyors.

ROLLING STOCK VALUES.

An important ruling of the Court is now that in ascertaining factors A, B, and C, the value of the railway company's rolling stock is to be estimated thus:—A deduction is to be made to cover the depreciation of each item since it was last reconditioned; further, a deduction is to be made to cover depreciation which is due to the type becoming obsolete; but an addition is not to be made to represent the profit which would have been made by a manufacturer supplying plant to the (hypothetical) tenant; actual cost to the railway company is the figure at which each item is to be taken into account.

Replacement cost of rolling stock, said the Court, must admittedly be looked to, but replacement is not to be charged by the railway company at actual cost *plus* profits which might be made by an outside manufacturer (if the company did not act as its own manufacturer); in any event, such an outside manufacturer's prices could not be estimated to be higher than the company's own, since any economies effected by the railway company's mass production facilities would presumably be available also to such an outside manufacturer, for he would also be working on mass production lines.

MAINTENANCE PLANS.

The railway company had argued, further, that the tenant's capital included "dies, patterns, moulds, drawings, and plans." The company, the Court declared, should make allowance in their calculation of cost price of maintaining stock in repair, so far as such items might be relevant thereto; but to include them under the two headings was wrong. So far as they might be relevant to the maintenance of the permanent way, a tenant was not bound to buy plans from his landlord; it was open to him to borrow them.

Each undertaking must be considered upon its own merits. As for the Southern Railway Company, the Court put the capital at £27,610,690; the percentage figure was 15 per cent., and the net receipts £5,408,000; the tenant's share of receipts derived otherwise than from the use of the rolling stock was £189,266.

APPEAL COSTS.

The appeal of the railway company was, accordingly, allowed, their costs to be paid by the Railway Assessment Authority; and in calculating such costs there were to be included costs occasioned or increased by the appeals of the local authorities; the local authorities, in turn, were directed to pay the costs of the Railway Assessment Authority.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

LEAD PIPES.

Nos. 602—1935 and 603—1935. The pipes covered by these specifications range in diameter from ¾in. up to 6in., and in different weights according to the purpose for which they are to be used. The lead pipes of large diameters are designed for soil and waste purposes, and provide a further standard in the series of B.S. Specifications now available for soil and waste pipes. B.S.S. No. 602 is for ordinary lead pipes, whilst B.S.S. No. 603 is for an alloy lead known as ternary alloy which has been developed by the British Non-Ferrous Metals Research Association. The specifications lay down the chemical composition of the material used, the weights for the various sizes of pipes, and the turn pin test. The frequent marking on the pipes of the internal diameter and the weight is also required.

STANDARD COLOURS FOR DESIGNATION OF VOLTAGES.

No. 77—1932. In drawing maps and diagrams of high-voltage transmission networks it is often necessary to distinguish between the different voltages. In many instances the most convenient method is to employ a colour scheme, and a standard colour code has now been issued by the British Standards Institution. This colour code is issued as an addendum to British Standard Specification No. 77—1932, Voltages for New Systems and Installations, and copies (Ref. CD (EL) 6497) will be forwarded gratis on receipt of a stamped envelope by the Publications Department.

FORTHCOMING SPECIFICATIONS.

Density Hydrometers.—The Hydrometer Sub-Committee has prepared a draft specification for British Standard Density Hydrometers and tables for use with the hydrometers. The draft specification and tables are now being circulated to interested bodies for criticism prior to their final publication. The Institution would welcome comments on the proposals from as wide a circle as possible, and a copy of the draft specification and tables will be forwarded to anyone interested on application to the Director.

Markets, Notes and News.

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

A Long-term Anglo-Continental Pact.

So much has been heard during the past few months of the discussions between the British and Continental steel makers, the quota for the latter in the British markets, and another for both parties in the export markets, that the conclusion of a long-term agreement seems almost an anti-climax. The terms, which were settled at Luxembourg last week, are certainly more favourable to the British than at one time seemed likely. It is understood that there are a few details still to be settled, but it is not thought likely that any last-minute difficulties will arise. In brief, the terms of the arrangement, so far as they are known, are that the Cartel countries have accepted a quota of 670,000 tons for the first year, which is to include all descriptions of steel imported into this market from Cartel countries, and 525,000 tons per annum for the remainder of the agreement, which is for a period of five years, but which may be terminated at the end of three. The tonnage for the first year includes all rolled products, semis, wirebars, wire and wire materials. At first sight, it may be assumed that the British agreed upon a larger tonnage for the first year than was originally conceded, but although the temporary arrangement provided for a quota at the rate of 643,000 tons per annum, this related to rolled products and semis only. It is now estimated that when the tonnage of other products is deducted from the 670,000 tons, the imports of rolled products will be limited to about 600,000 tons. It is also expected that the 43,000 tons less allowed the Cartel will be deducted from the quota of semis. This latter arrangement was probably a sop to the Continental steel makers, as it has been known that they have desired a smaller quota of semis and a higher tonnage of finished steel material. There are, of course, a number of details of great importance to the British, as well as the Continental steel trade that have not been settled. How the imports into this country will be controlled is a matter of considerable interest. Apparently this point has not yet been decided, but it is unlikely that the Continental steel makers will allow this work to pass out of their hands. Another question that the market would like to be reassured upon is whether any alteration is contemplated in the existing 33⅓ per cent. duties. A section of the Continental steel makers was definitely hoping that in the event of an agreement being reached, the British Government might be persuaded to reduce the duty to at least 20 per cent.

Pig Iron.

The approach of the Whitsun holidays naturally had the effect of slowing down business in the latter part of last week, and the market has scarcely yet had time to settle down after the break. The general characteristics of the position, however, are unchanged. Consumers are encouraged by the existence of substantial stocks in some districts to pursue a policy of covering only their near requirements, and this in some cases has been carried so far that expiring contracts have not been renewed. At the same time the turnover in the market is probably heavier than at any time this year, judging by the estimate that May was the best trading month since December, as allowing for the Whitsun holidays the first few days in June certainly maintained the level of the previous month. On the North-East Coast, local deliveries continue to be made on a heavy scale, but the shipments to Scottish consumers have not been altogether satisfactory. The stocks on the North-East Coast are not large, and the makers claim that the current production is passing into consumption. At the same time, there are indications that consumers are turning to other brands, and that the quotation for Northamptonshire iron in Scotland at 1s. 3d. less than Cleveland is having its effect upon the demand for the latter iron. In spite of this, the Cleveland makers continue to quote for Scottish business on the basis of 70s. 3d. d/d Glasgow and 67s. 3d. d/d Falkirk. During May the volume of business was distinctly disappointing, even though the Cleveland makers did not set themselves out to secure orders for overseas markets. Nevertheless, the total shipments of all classes of pig iron last month amounted to 9914 tons, compared with 11,965 tons in April. Business in Midland irons showed some improvement in the week preceding the holidays, and some contracts were renewed, although the general inclination amongst consumers has been to buy from hand to mouth in the fairly certain belief that so long as stocks at the furnaces remain at their present level there is little likelihood of an increase in prices. In Lancashire the demand is steady and a cheerful aspect of the situation is that a number of contracts have been renewed, although new forward buying on any scale is rarely heard of. The Scottish market is steady, but the production at the local furnaces is well absorbed. The producers of hematite are meeting with a strong demand, and a fair amount of new business has been placed lately. Export trading, however, is not satisfactory, although a few transactions have been entered into lately with Scandinavian buyers.

The Midlands and South Wales.

Conditions in the Midland finished steel trade must be considered satisfactory, as the absence of Continental competition is now making itself felt by an increased demand for British material of all descriptions. There is still enough Continental material in stock and entering the country against old contracts to prevent anything in the nature of excessive pressure upon the home manufacturers. Some consumers, however, are showing greater inclination to contract forward than they have done for some time. It is reported that some of the steel works are now holding important consumers covered against work they tender for on the understanding that the orders for the steel will only be booked if the tenders are successful. Constructional engineering concerns in the Midlands are moderately well provided with work, but anticipate increased booking in the coming weeks, partly as a result of the Government's Air Force programme, which will include the construction of a number of new aerodromes. Contrary to the position existing a month or two ago, light sections are not in nearly such good demand as the heavy descriptions, and a number of the steel works would like to book some good contracts for the former. The request for joists lately has expanded, and most makers are now carrying good contracts for this description of steel. Re-rollers in the Midlands appear to be somewhat irregularly employed, and whilst a few are running practically full time, others are not so well off for work. As the agreement with the Continent takes effect upon the market, it is anticipated that there will be a general expansion in consumers' requirements for re-rolled material. The quotation for small bars remains unaltered at £8 12s., less rebates varying from 2s. 6d. to 5s. Unassociated works which lately were quoting £7 12s. 6d. delivered, are showing a tendency to advance their prices since they have no longer to meet the competition of Continental steel. The situation in South Wales has improved, and most of the works closed for the holidays with well-filled order books. There is a good local demand for constructional material, and in some cases South Wales works are booked up till the end of the year. The tin-plate mills are operating at about 53·55 per cent. of the allotted capacity, and lately sales have exceeded production. The quotation for tin-plate bars has been advanced from £5 2s. 6d. to £5 5s. d/d.

The North-East Coast and Yorkshire.

Optimism, born of the activity which has ruled in the home market since the pact between the British and Continental steel makers came into existence, continues to characterise the trade situation on this coast. The producers of semis have taken orders amounting to a large tonnage as a result of the Continental steel makers having sold their quota for the British market until the beginning of August, and are now in a strong position. For some time the output of billets and, to a lesser degree, of sheet bars, has been on a heavy scale, and specifications have been reaching the works at a satisfactory rate. Many of the mills are specially fitted for the supply of shipbuilding material, and perhaps the most disappointing feature of the position is the poor demand from this industry. Inquiries for a number of new ships are in circulation, but there seems to be much hesitation on the part of shipping companies in releasing orders. However, it is understood that when official sanction can be obtained contracts for two 9000-ton ships will be placed with builders on the Tees. There has been a good demand for special steels, and for some time past the steel makers in this district have turned their attention to the development of this side of their business. Now that it has been decided to increase the Air Force, an important expansion in Government requirements is expected. The activity in the structural steel section of the market is well maintained, and although some of the contracts that have been keeping the constructional engineering firms busy are approaching completion, it is believed that others will be forthcoming to replace them. The demand from this industry, in fact, provides one of the principal outlets for the steel works, and seems likely to remain at a high level for some time to come. The recent orders for railway material have improved the position of the works producing this class of steel, but further orders would be welcome. There has been a decline in export business and the statistics for May show that the shipments of steel from the Tees in that month were only 19,594 tons, against 31,500 tons in April. Reports from Sheffield and the Yorkshire steel markets indicate rather less pressure of business in basic steel than was the case up to Easter. The manufacturers are well provided with orders and are making good deliveries, but lately the amount of fresh work has suffered one of those temporary lapses which occasionally occur. The demand for acid carbon billets shows signs of expanding. Quotations for these are steady, from £6 15s. for rivet forgers' quality to £11 7s. 6d. for 1·5 to 2 per cent. carbon.

Current Business.

A contract valued at £1900 has been placed with Hadfields Ltd., Sheffield, for drill steel for use in mines in California. An order has been placed with British Auxiliaries, Ltd., Govan, for 1050 b.h.p. generating engines for Madeira. Another contract has been taken for two 1400 b.h.p. generating engines for Palmerston, New Zealand. The Air Ministry has placed contracts for the construction of aeroplane hangars in several districts with Wright, Anderson and Co., Ltd., structural engineers, of Gateshead. The sale is being negotiated of the ironworks of William Whitwell and Co., Ltd., of Thornaby-on-Tees, including three blast-furnaces, by-product plant, coal washing and briquetting plant, and coke ovens. Orders for the machinery for three colliers to be built by the Burntisland Shipbuilding Company, Ltd., for the Fulham Borough Council have been secured by the North-Eastern Marine Engineering Company, Ltd., of Wallsend. Henry Meadows, Ltd., of Wolverhampton, have taken Government contracts for high-efficiency engines, as well as an important contract for marine engines from the British Power Boat Company, of Southampton. An order for a passenger and cargo steamer of 1362 tons gross for the Leith, Hull, and Hamburg Steam Packet Company, Ltd., of Leith, has been secured by Barclay, Curle and Co., Ltd., of Glasgow. A factory at Kingswood, Bristol, used for the construction of Douglas motor cycles and light aero-engines, has been purchased by the British Pacific Trust, and work will be started on the manufacture on a large scale of aero-engines and accessories for military and civil aircraft. The Department of Overseas Trade reports that the following contracts are open for tender:—South African Railways and Harbours: two boilers with all accessories, including soot blowers, coal and ash-handling plant, motors, fans, feed pumps, &c., and steel-framed buildings (Johannesburg, August 12th); Johannesburg Electricity Supply Commission: 1500-kW traction sub-stations for the Randfontein-Springs sections of the South African Railways (Johannesburg, August 15th); Argentine State Oilfields Directorate: six Diesel-driven piston pumping sets, capacity 10 cm. per hour at a normal working pressure of 30 atms. (Buenos Aires, July 10th); Egyptian Ministry of Public Works: one airblower, positive delivery rotary type, for belt drive (Cairo, July 15th); Wellington, Posts and Telegraphs Department: 150 miles tinned annealed copper vulcanised india-rubber insulated wire (Wellington, August 2nd); 150 miles of one-pair 20 lb. conductors, enamel and cotton covered impregnated and lead sheathed telephone cable (August 2nd, Wellington); 50 miles of P.J.B. insulated wire to B.P.O. specification 365-G. (Wellington, August 1st).

Copper and Tin.

The copper market has experienced the setback that was generally expected, and probably the great majority of dealers now anticipate a steady appreciation in values. The fall in prices was long delayed, and when it came went further than the market believed possible. In all likelihood, the French currency crisis had more to do with the collapse in prices than the complications in the United States. Once having reached agreement on the difficult problem of output restriction and shipments from America to Europe, it was incredible that the copper producers would willingly throw away months of work merely to revert to the chaotic conditions which previously existed. On the other hand, the obvious danger of France abandoning the gold standard, allied with the political ferment in that country, was bound to have a depressing effect upon a department so sensitive to outside influences as the copper market. It is possible also that the steps taken by the French authorities to stop speculation in francs may have prevented a large volume of hedging in copper against the depreciation of the currency. It is certain that, unlike other occasions when a gold currency has been on the verge of toppling, there has been comparatively little buying. There is no doubt that the market was in a position in which a reaction could do little harm. Whilst there was a heavy bull account open, prices had advanced so rapidly that in spite of the fall, most operators were able to take a profit, although, of course, the liquidation of these accounts still further depressed values. Before the holidays, the temper of the market changed, and in spite of some fluctuations there was a noticeable inclination to look for a steady advance. The producers have announced that the restriction plan has been put into operation, and even if it no longer has the support of the American laws, there seems no probability of its being broken. . . . In spite of the rigid control exercised over the tin market, it is passing through a somewhat uneasy time. It is generally believed that those who are responsible for operating in the market for the Control can put the price where they like, but one result of the disturbed conditions in France and the United States has been severely to check buying by consumers, both in America and on the Continent. There is talk in the market that representations which have been made recently to the authorities have not been without effect, and that at their meeting this week the International Tin Committee will raise the quota the producers may market. This should ease the position, which at the moment is still very tight.

Lead and Spelter.

Although prices have fallen recently in the lead market, the movement has been largely of a sympathetic character and resulted more from the decline in values in other non-ferrous metal departments than any deterioration in the lead position. For a time the demand from users in this country fell off, but this was probably due to their natural reluctance to buy on a falling market. This abstinence had the effect of accelerating the decline in prices. When the turn in the market came and prices began to recover users resumed buying steadily and have continued to do so. The demand from manufacturers of lead products is one of the features of the British metal trades, and with slight fluctuations has continued for a long period at a higher level than for years past. Owing to the operation of the lead duty it is entirely concentrated upon Empire brands and English lead. There is a certain amount of stringency in the supplies of these descriptions, with the result that rather high premiums are again causing some complaint. It is understood that a scheme for replacing the present 10 per cent. *ad valorem* duty with a flat rate of 7s. 6d. per ton has been agreed to by all the interests concerned in the British market and has been passed by the Import Duties Advisory Committee; but that as the present duty was the outcome of the Ottawa agreement Empire Governments have to be consulted with regard to the change. . . . The spelter market also suffered from the general relapse in metal prices assisted by some rather active selling by operators who saw an opportunity of making a profit. At one time the spot price of the metal fell below that of lead; but the recovery in this market was rapid, although later some uncertainty developed. There is a fair industrial demand for spelter in this country, but the requirements of Continental consumers seem to have shrunk during the past week or two. There is again talk of a revival of the International Spelter Cartel, which apparently springs from the belief that if conversations that are known to be going on between the lead producers result in an agreement it is practically certain that something will be done for spelter. This week there were some arrivals of foreign metal, which were used in settlement of open contracts. Although supplies of Empire spelter are not heavy, there has been no demand for warehouse metal.

Current Prices for Metals and Fuels.

Makers' official home trade prices, per ton, delivered buyers' stations. Sections, joists and plates are subject to a rebate to home users purchasing only from associated British Steelmakers: joists 22s. 6d.; plates and sections, 15s. Export orders of 250 tons and over may be subject to special quotations.

PIG IRON.

	Home.	Export.
	(*D/d Teesside Area*)	
N.E. COAST—	£ s. d.	£ s. d.
Hematite Mixed Nos.	3 8 6	3 2 0
No. 1	3 9 0	3 2 6
Cleveland—	(*D/d Teesside Area*)	
No. 1	3 10 0	3 4 0
No. 3 G.M.B.	3 7 6	3 1 6
No. 4 Forge	3 6 6	3 0 6
Basic (*Less 5/- rebate*)	3 10 0	—
MIDLANDS—		
Staffs.—	(*Delivered to Black Country Station*)	
North Staffs. Foundry	3 11 0	—
" " Forge	3 6 6	—
Basic (*Less 5/- rebate*)	3 15 0	—
Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
SCOTLAND—		
Hematite, f.o.t. furnaces	3 11 0	—
No. 1 Foundry, ditto	3 12 6	—
No. 3 Foundry, ditto	3 10 0	—
Basic, d/d (*Less 5/- rebate*)	3 10 0	—
N.W. COAST—		
Hematite Mixed Nos.	3 12 6 d/d Glasgow; 4 0 6 " Sheffield; 4 5 6 " Birmingham	

MANUFACTURED IRON.

	Home.	Export.
LANCS.—	£ s. d.	£ s. d.
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
S. YORKS.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
MIDLANDS—		
Crown Bars	9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	7 10 0 to 8 0 0	—
SCOTLAND—		
Crown Bars	9 12 6	9 5 0
Best	10 2 6	9 15 0
N.E. COAST—		
Common Bars	9 12 6	8 15 0
Best Bars	10 2 6	9 15 0
Double Best Bars	10 12 6	10 0 0

STEEL.

	Home.	Export.
LONDON AND THE SOUTH—	£ s. d.	£ s. d.
Angles	8 10 0	7 7 6
Tees	9 10 0	8 7 6
Joists	8 17 6	7 7 6
Channels	8 15 6	7 12 6
Rounds, 3in. and up	9 10 0	8 7 6
" under 3in.	8 14 6	7 0 0
Flats, 5in. and under	8 14 6	7 0 0
Plates, ½in. (basis)	9 0 0	7 15 0
" ⅜in.	9 5 0	8 0 0
" ½in.	9 10 0	8 5 0
" ⅝in.	9 15 0	8 10 0
" ¾in.	9 10 0	8 5 0
NORTH-EAST COAST—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
" under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ½in.	8 15 0	7 15 0
" ⅜in.	9 0 0	8 0 0
" ½in.	9 5 0	8 5 0
" ⅝in.	9 10 0	8 10 0
" ¾in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 5 0	8 5 0
MIDLANDS, AND LEEDS AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
" under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ½in. (basis)	8 17 6	7 15 0
" ⅜in.	9 2 6	8 0 0
" ½in.	9 7 6	8 5 0
" ⅝in.	9 12 6	8 10 0
" ¾in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 7 6	7 15 0 to 8 5 0

STEEL (*continued*).

	Home.	Export.
GLASGOW AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
" under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ½in. (basis)	8 15 0	7 15 0
" ⅜in.	9 0 0	8 0 0
" ½in.	9 5 0	8 5 0
" ⅝in.	9 10 0	8 10 0
" ¾in.	9 5 0	8 5 0
Boiler Plates	9 5 0	8 5 0
SOUTH WALES AREA—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 0
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
" under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ½in. (basis)	8 17 6	7 15 0
" ⅜in.	9 2 6	8 0 0
" ½in.	9 7 6	8 5 0
" ⅝in.	9 12 6	8 10 0
" ¾in.	9 10 0	8 5 0

IRELAND—	Belfast.	Rest of Ireland.
	£ s. d.	£ s. d.
Angles	8 12 6	8 15 0
Tees	9 12 6	9 15 0
Joists	9 0 0	9 2 6
Channels	8 17 6	9 0 0
Rounds, 3in. and up	9 12 6	9 15 0
" under 3in.	9 2 0	9 4 6
Plates, ½in. (basis)	9 0 0	9 2 6
" ⅜in.	9 5 0	9 7 6
" ½in.	9 10 0	9 12 6
" ⅝in.	9 15 0	9 17 6
" ¾in.	9 12 6	9 15 0

OTHER STEEL MATERIALS.

	Home.	Export.
Sheets.	£ s. d.	£ s. d.
10-G. to 13-G., f.o.r.	9 0 0	8 15 0
14-G. to 20-G., d/d	10 5 0	9 0 0
21-G. to 24-G., d/d	10 10 0	9 5 0
25-G. to 27-G., d/d	11 2 6	9 17 6

The above home trade prices are for 4-ton lots and over; 2-ton to 4-ton lots, 10s. per ton extra; and under 2-ton lots, 30s. per ton extra.

Galvanised Corrugated Sheets, Basis 24-G.

Home.	£ s. d.
4-ton lots and up	13 0 0
2-ton to 4-ton lots	13 7 6
Under 2 tons	15 0 0

Export: £12 15s. 0d., c.i.f. duty paid India.
" £11 5s. 0d., f.o.b. other markets.
" Scandinavian Markets free.

Tin-plates.
20 by 14 basis, f.o.b. Bristol Channel Ports, 12/2 to 19/2.
Tin-plate Bars, d/d South Wales Works, £5 5s. 0d.

Billets.	£ s. d.
Basic (0·33% to 0·41% C.)	6 12 6
" Medium (0·42% to 0·60% C.)	7 2 6
" Hard (0·61% to 0·85% C.)	7 12 6
" " (0·86% to 0·99% C.)	8 2 6
" " (1% C. and up)	8 12 6
Soft (up to 0·25% C.), 500 tons and up	5 10 0
100 to 250 tons	5 17 6
Rails, Heavy, 500-ton lots, f.o.t.	8 10 0
" Light, f.o.t.	7 10 0

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/3 per lb.	
Ferro Tungsten	3/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/-
" " 6 p.c. to 8 p.c.	£21 10 0	7/-
" " 8 p.c. to 10 p.c.	£21 10 0	7/-
" " Specially Refined		
" " Max. 2 p.c. carbon	£34 0 0	11/-
" " " 1 p.c. carbon	£36 5 0	11/-
" " " 0·70 p.c. carbon	£37 5 0	12/-
" " " carbon free	9½d. per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (loose)	£10 15 0 home	
" Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- p.u.	
" " 75 p.c.	£17 17 6 scale 6/- p.u.	
" Vanadium	12/8 per lb.	
" Molybdenum	4/6 per lb.	
" Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£200 to £205	
Cobalt	5/- to 5/6d. per lb.	

NON-FERROUS METALS.

Official Prices, June 12th.

COPPER—		
Cash	£31 18 9 to £32 0 0	
Three months	£32 6 3 to £32 7 6	
Electrolytic	£35 5 0 to £35 10 0	
Best Selected Ingots, d/d Birmingham	£35 10 0	
Sheets, Hot Rolled	£64 0 0	
	Home.	Export.
Tubes, Solid Drawn (basis)	10d.	10d.
" Brazed (basis)	10d.	10d.
BRASS—		
Ingots, 70/30, d/d Birmingham	£31 0 0 to £32 0 0	
	Home.	Export.
Tubes, Solid Drawn, 2/1 Alloy	9½d.	9½d.
" Brazed	11½d.	11½d.
TIN—		
Cash	£224 5 0 to £224 10 0	
Three months	£218 10 0 to £218 15 0	
LEAD: Cash and forward	£14 0 0	
SPELTER	£14 0 0 to £14 3 9	
Aluminium Ingots (British)	£100	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
f.o.b. Grangemouth—Navigation Uncreened	13/- to 13/6
" Glasgow—Ell	14/6 to 15/6
" " Splint	17/- to 17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/- to 14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—	
Prime Steam	13/3 to 13/6
Unscreened Navigation	12/9 to 13/-
LOTHIANS—	
(f.o.b. Leith)—Hartley Prime	13/-
Secondary Steam	12/- to 12/3

ENGLAND.

YORKSHIRE, MANCHESTER—	
B.S.Y. Hard Steams	18/6 to 21/6
Furnace Coke	15/- to 16/-
NORTHUMBERLAND, NEWCASTLE—	
Blyth Best	14/- to 14/3
" Second	13/3 to 13/6
" Best Small	10/6 to 11/-
Unscreened	12/6 to 13/6
DURHAM—	
Best Gas	14/6
Foundry Coke	19/- to 20/-

SHEFFIELD—	Inland.
Best Hand-picked Branch	23/- to 25/-
South Yorkshire Best	20/- to 22/-
South Yorkshire Seconds	17/- to 18/6
Rough Slacks	8/- to 9/-
Nutty Slacks	7/- to 8/6

SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Admiralty Large	19/6
Seconds	19/- to 19/6½
Best Dry Large	18/9 to 19/3
Ordinaries	18/3 to 18/6
Best Bunker Smalls	13/6 to 14/-
Cargo Smalls	11/6 to 12/6
Dry Nuts	22/- to 26/-
Foundry Coke	24/- to 37/6
Furnace Coke	19/- to 21/6
Patent Fuel	21/-
SWANSEA—	
Anthracite Coals:	
Best Large	36/- to 40/-
Machine-made Cobbles	41/- to 48/6
Nuts	40/- to 48/6
Beans	25/- to 30/-
Peas	19/- to 23/-
Rubbly Culm	11/- to 12/-
Steam Coals:	
Large Ordinary	18/- to 20/6

FUEL OIL.

Inland consumption; contracts in bulk.
Exclusive of Government tax of 1d. per gallon.

Ex Ocean Installation.	Per Gallon.
Furnace Oil (0·950 gravity)	3½d.
Diesel Oil	4d.

French Engineering Notes.

(From our own Correspondent in Paris.)

Stabilisation and Trade.

THE dangerous condition of the franc, with the risk of unsuspected consequences that might have ensued had it been forced off the gold standard, will compel the new Government to do everything possible to ensure relative stability amongst the three countries principally concerned until conditions allow of an effective stabilisation on an acceptable basis. During the period of suspense business was paralysed. The industrial situation still remains precarious, not only through the abstention of private enterprise, which was already at a very low ebb, but more particularly because the decline of State credit left meagre chances of money being procurable for necessary expenditure to carry out works which are to keep the industrial machinery in partial operation. The belief that something may now be done to continue that programme has inspired more confidence. The industrial future is, however, still uncertain, for supposing that relative stability can be achieved, there can be no activity without a deflation of internal values that will bring down the costs of production to somewhere near the level of those in sterling groups of countries. A policy of deflation has been carried on with only small success, and that success is really the consequence of a disastrous depreciation of home-grown commodities, which has had no effect in lowering production costs. These can only be reduced by relief from heavy taxation. No real recovery is possible without a change in the economic system that will allow of the world's markets being opened again to French products. But all attempts to reach liberal trade agreements abroad are impeded by difficulties that beset a country which is both industrial and agricultural, and where, nationally, the agricultural industry is by far the more important. So far as foreign trade is concerned, the interests of both are in opposition. Agriculture wants the manufacturing industries to make sacrifices for the reopening of foreign markets to French produce, but manufactures have developed to an extent that renders such sacrifice difficult, except by eliminating certain industries that cannot exist without complete protection. All the mechanical industries are grouped in the powerful Fédération de la Mécanique, which cannot make any distinction amongst its members, and its policy favours the system of strict reciprocal exchanges to be arranged by industrial groups in a manner to avoid most-favoured-nation treatment. All efforts to retrieve the situation by such narrow methods of foreign trade exchanges are at a deadlock, and the only hope of a real recovery lies in the Government finding itself obliged to deal with the problem in a more general and comprehensive manner.

Work on the Rhone.

It was just a year ago that the Compagnie Nationale du Rhône obtained the concession for the execution of navigation, hydro-electric, and irrigation works on the Rhône between the Lake of Geneva and the Mediterranean, and it recently held a first annual meeting, at which little could be done except to report upon the programme of work to be put in hand. It will start with the construction of hydro-electric power stations, of which there will be twenty, producing a total of 9000 million kWh a year. The present time is obviously not favourable to an undertaking of this kind when the production of electricity is far in excess of requirements, and the work of constructing barrages and installing power plants will only be continued so far as it is justified by an industrial revival and by arrangements that can be made with hydro-electric companies in the Alps to participate in the supply of energy to Paris. The irrigation plans appeal to more immediate needs, but here, again, electrical energy will be required for pumping over large areas. Nothing is yet definitely settled as to how the Rhône is to be made navigable above Lyons, but according to the report it is likely that the scheme for a lateral canal will be adopted for the entire length of the river, though there are many matters to be considered before a final decision can be reached. For commercial reasons the hydro-electric and irrigation works are preparatory to the main task of rendering the Rhône navigable above Lyons, and improving navigation facilities below, but it does not appear likely that much will be done until the depression gives way to an industrial recovery, and it becomes possible to see more clearly in what manner the enterprise can be carried through successfully. Meanwhile, there is a good deal of activity in extending and equipping the port of Lyons with a view to dealing with a considerable increase of river and canal traffic in the future.

The Steel Negotiations.

The results obtained at the meeting of British and Continental steel makers at Luxembourg have inspired optimism in the French steel trade, which sees an elimination of difficulties that stood in the way of a complete understanding. The conciliatory attitude of the British delegates is said to have allowed both parties to settle the general lines of a five years' agreement, which provides for a quota of 670,000 tons of Continental steel into Great Britain during the first year, after which time the quantity will be reduced to 525,000 tons per annum to include all classes of steel exported from Cartel countries. No concession was made by British steel makers on their claim to take the exports during 1934 as a basis for their participation in the foreign trade, and as there appear to be differences in the published statistics regarding those exports, the Continental delegates could not accept the British figure without verification, so that there will be some delay in the final settlement. In any case, the agreement would not become operative in less than six weeks. Moreover, there is much to be done before then, for not only are Continental makers anxious to renew the rail and ship plate conventions before the new agreement comes into force, but they have also to settle amongst themselves the division of steel tonnage to be exported to Great Britain, which is not going to be an easy matter.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

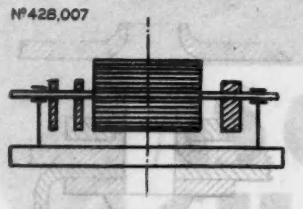
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

428,007. August 4th, 1934.—ELECTRIC MOTORS FOR PRODUCING VIBRATIONS, R. Bloem, 32, Avenue Victor Jacobs, Brussels, Belgium.

The invention relates to electric motors for producing vibrations for tamping granular materials, concrete, and like products. Motors of this kind are known in which a mass excentric relative to the axis of rotation of the rotor—that is to say, a mass whose centre of gravity is outside and at a certain distance from this axis—is mounted at one end of the shaft of the rotor. In motors of this kind, the rotation of the rotor has the effect of producing, in addition to the desired vibrations, unsymmetrical actions on the shaft and the motor, which tend to make the whole motor arrangement turn about geometrical axes perpendicular to the shaft of the motor. In order to overcome these disadvantages, according to the present invention, each rotor is provided with a plurality of masses, some of which are situated on one side of the plane of symmetry of the rotor perpendicular to the axis of rotation, and the others of which are situated on the other side of this plane, so that the sum of the moments produced by the centrifugal forces due to the masses around an axis perpendicular to the shaft of the rotor and situated in the plane of the latter will be zero.—*May 3rd*, 1935.

Nº428,007

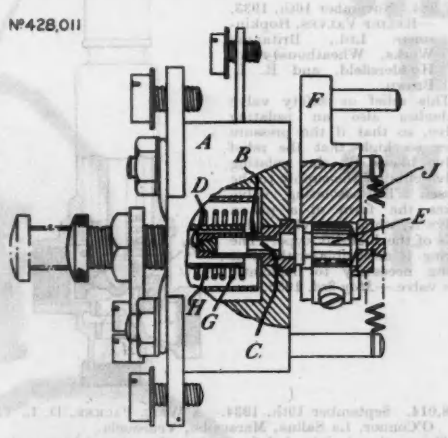


SWITCHGEAR.

428,011. August 20th, 1934.—THERMALLY CONTROLLED SWITCHES, Brookhirst Switchgear, Ltd., Northgate Works, Chester, and J. S. Davies, 40, West-grove, Rhostyllen, near Wrexham, Denbigh.

This is an overload device for use in connection with a circuit breaker. To the base A there is fixed a sleeve B, inside which there is a stem C. The two are united by solder at D. The stem carries the ratchet E inside the switch lever F. Surrounding the sleeve B there is a heating element G, which is in the main circuit, and the shield H. This shield can be adjusted to screen, more or less, the sleeve from the heating element. Normally, the switch lever F is held by the ratchet in the open position against the tension of the spring J, but if the solder is melted by the overloading of the heater G it is released and the switch in the circuit of the hold-on coil of the circuit breaker opened. The device can be reset when the solder has solidified again.—*May 3rd*, 1935.

Nº428,011

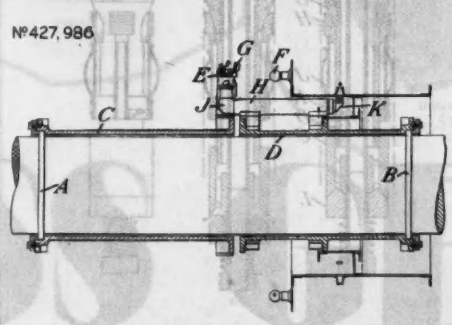


MEASURING AND TESTING INSTRUMENTS.

427,986. December 6th, 1933.—A TORSION METER, E. R. Watts and Son, Ltd., 123, Camberwell-road, London, S.E.5, W. J. Guthrie, and V. W. H. Towns.

This is a torsion meter for measuring the shaft horse-power of, say, a steamship. Two flanges, A and B, are formed on the shaft, and are of relatively large diameter compared with their thickness, so that the torque in the shaft produces little effect on them. To these flanges there are bolted the two tubes C and D. The tube C carries the transparent scale E, which is illuminated by the lamp F, lens and mirror G. The other tube D carries the microscope H, which has a prism at J and an eyepiece at K. The displacement of the scale with respect to a line on the microscope is a measure of the power being transmitted through the shaft.—*May 3rd*, 1935.

Nº427,986

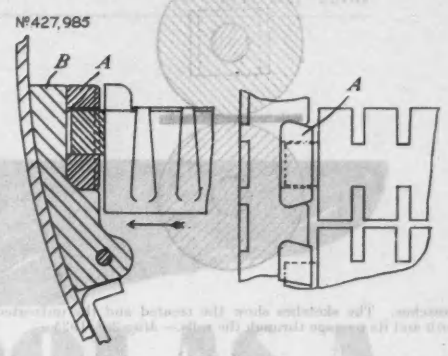


FURNACES.

427,985. November 22nd, 1933.—ROCKER FIRE-BARS, J. W. Hartley, Drysdale House, Stone, Staffs.

The inventor adopts a transverse fire-bar which can be rocked from time to time to remove the ashes. In order to protect the trunnions from the abrasive action of the ashes and yet allow the bars to be removed, the trunnions are set in loose blocks A, which completely encase them in contradistinction to the usual method of open slots. The blocks are then dropped into recesses in the side bearer bars B.—*May 3rd*, 1935.

Nº427,985



PUMPING AND BLOWING MACHINERY.

427,987. December 9th, 1933.—CENTRIFUGAL PUMPS, Mather and Platt, Ltd., Park Works, Newton Heath, Manchester, 10, and R. Pennington.

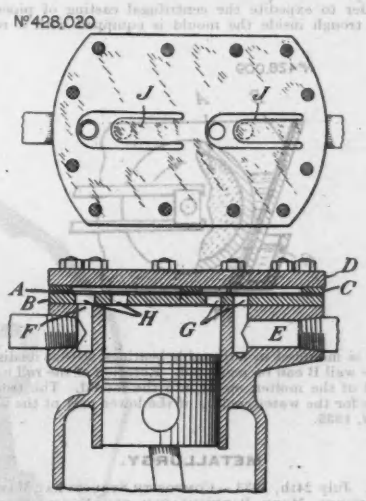
This invention relates to centrifugal pumps, and particularly to multi-stage pumps for boiler feed purposes, and has for its object to provide simple and effective means for preventing damage to the neck bushes around the pump shaft or impeller bosses should the water supply to the pump fail or should the pump become steam-logged from any cause. This is effected by the provision, in combination with a water main or bus pipe, of branch pipes, each with a non-return valve therein leading through the pump body to a neck bush so that when the pressure in a pump stage falls below that of the water in the main or bus pipe, water enters the stage and lubricates the neck bush. The drawing is self-explanatory.—*May 3rd*, 1935.

Nº427,987

428,020. November 9th, 1934.—AIR COMPRESSOR VALVES, *E. W. Moss, 75, Victoria-street, London, S.W.1.*

The valves of this compressor are formed out of a plate A of thin steel. This plate is clamped between a cylinder cover plate B, a spacer C, and an outer cover D. The inlet to the compressor is shown at E, and the delivery at F. The plate B is pierced with inlet ports at G and outlet ports at H, while the spring plate A is cut as shown in the plan view to provide fingers J J, which act as valves over the ports.—*May 3rd*, 1935.

Nº428,020



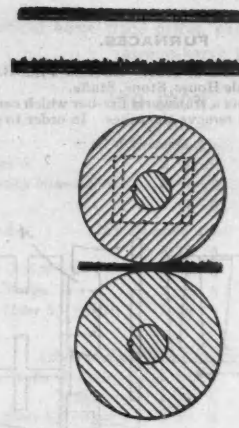
CRUSHING AND GRINDING.

427,978. November 3rd, 1933.—ABRASIVE CLOTHS, *W. J. Tennant*, 111, *Hatton-garden, London, E.C.1.*

The inventors make abrasive cloths in the usual manner by cementing the abrasive, silicon carbide, on to the base, and then pass the cloth between hard-faced rolls of manganese bronze or steel. In this way protruding points of the abrasive are crushed down to the normal level. The improved abrasive is said to possess the advantage of being fast cutting. Dust will not accumulate upon its abrading surface, owing to the space separating its abrasive particles. The cloth possesses the good wearing quality characteristic of ordinary coarse abrasive,

and will not scratch, the treated surface obtained by its use being homogeneous throughout and free from defacing lines or

Nº 427,978



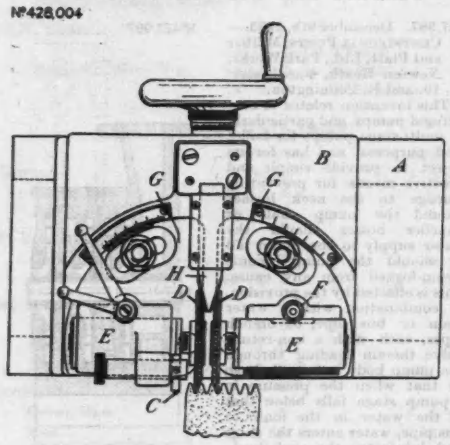
scratches. The sketches show the treated and the untreated cloth and its passage through the rolls.—*May 3rd*, 1935.

MACHINE TOOLS AND SHOP APPLIANCES.

428,004. July 23rd, 1934.—TRUING PROFILED GRINDING TOOLS, *F. Watson, Aldwych House, Aldwych, London, W.C.2.*

This device is intended for truing up the grinding worms of worm grinding machines. The slide A can be moved along the length of the worm and the slide B at right angles. B carries

Nº 428,004

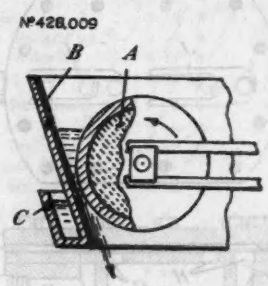


a diamond C for truing the outside diameter of the grinding worm, and the two truing discs D D. These discs are free to rotate in the bearings E E, which can be adjusted endways by the rack and pinion F. The bearings are mounted on the quadrant plates G G, and the angular position of the truing discs is adjusted to the gauge H.—*May 3rd*, 1935.

428,009. August 17th, 1934.—CENTRIFUGAL CASTING, H. Breitbart, 308, Adolf-Hitlerstrasse, Duisburg-Beck, Germany.

In order to expedite the centrifugal casting of pipes, the pouring trough inside the mould is equipped with a roll A.

Nº 428,009



The roll is mounted in adjustable bearings, so that its distance from the wall B can be regulated. Rotation of the roll hastens the feed of the molten metal into the mould. The trough C provides for the water cooling of the lower part of the wall.—*May 3rd*, 1935.

METALLURGY.

427,719. July 24th, 1933.—COMPOSITE STRUCTURAL MATERIAL INTENDED MORE PARTICULARLY FOR ELECTRICAL PURPOSES, N. V. Molybdenum Company, Keizersgracht 564, Amsterdam, Holland, and P. Schwarzkopf, Reutte, Tyrol, Austria.

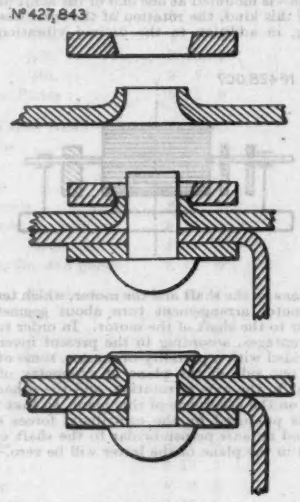
This invention relates to a composite structural material and shaped articles made therefrom intended more particularly for electrical purposes without however being limited to such use. The material is characterised by at least two intimately united sheets or sheet portions of which at least one consists of, or, contains substantial amounts of the high melting metals tungsten, molybdenum, and/or tantalum, while another consists of or contains substantial amounts of at least one of the lower melting metals, silver, gold, aluminium, cobalt, chromium, iron, nickel, copper, platinum, tin, zinc, the high-melting metal being present in ductile form derived from sintered or molten bodies of the metal. In making the material the high melting metals tungsten, molybdenum, and tantalum have to be obtained in ductile form derived from sintered or molten bodies of the metal. Sheets containing substantial quantities of high melting metal may be made in several ways. For example, metal of low melting point may be mixed with ductilised metal of high melting point in the form of powder, and the temperature of the mixture raised until the metal of low melting point melts. The hot bath is then allowed to subside; demixing then occurs to a more or less considerable extent and the heavier metal collects—*i.e.*, accumulates—at desired places. When the mixture sets a heterogeneous body is obtained, which is rolled or hammered down to a sheet. If electrical contacts are stamped out of such a sheet then these can be united with the support, *e.g.*, iron or aluminium spring, by soft soldering, all oxidation and structural change in the joined part being excluded. Sheets may also be coated with tin on the copper side or a sheet of tungsten-copper-tin may be made first of all when the soldering is particularly facilitated and soldering temperatures of 230 deg. Cent. and less may be employed. No oxidation nor impairing of the mirror-smooth highly lustrous rolled surface of the tungsten can take place, which latter surface on account of its great compactness is substantially more resistant to corrosion and oxidation than the surfaces of known contacts.—*April 24th*, 1935.

MISCELLANEOUS.

427,843. March 20th, 1934.—RIVETED CONNECTIONS, G. G. Parnall and C. Wood, Yate Aerodrome, Bristol.

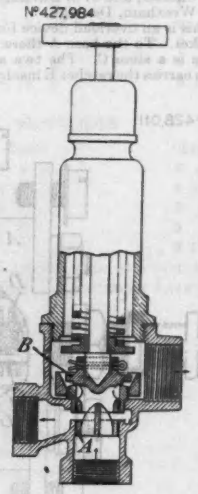
This is a riveted joint for thin metals, such as those used in

Nº 427,843



tank construction. Its production is so obvious in the drawings that no description is necessary.—*May 1st*, 1935.

Nº 427,984



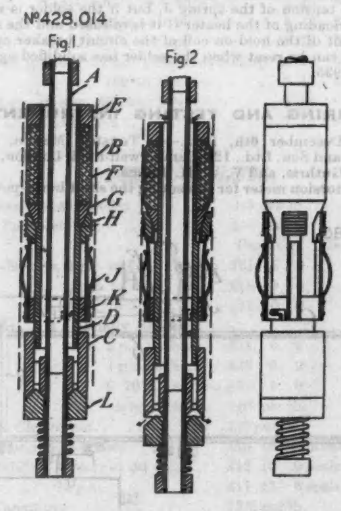
247,984. November 16th, 1933.—RELIEF VALVES. Hopkinsons, Ltd., Britannia Works, Wheathouse-road, Huddersfield, and R. L Brown.

This relief or safety valve embodies also an isolating valve, so that if the pressure rises so high that the relief valve blows off, the isolating valve cuts off the supply to the vessel. The isolating valve takes the form of a piston valve A, while the relief valve B is of the high-lift type. The spring is accessible without it being necessary to dismantle the valve.—*May 3rd*, 1935.

428,014. September 19th, 1934.—A WELL PACKER, D. L. T. O'Connor, La Salina, Maracaibo, Venezuela.

This packer is intended for sealing the space between the flow pipe A of a well and the wall of the bore-hole B. A spider ring C is screwed on to the end of the flow pipe and carries a sleeve D. At the upper end of this sleeve there is a collar E,

Nº 428,014



and below this a rubber sleeve F. The rubber sleeve rests on a V ring G, which fits into a split ring H. This ring is held in place by the springs J, attached to the ring K, which can slide on the sleeve D, but is temporarily held by a bayonet catch. The device is lowered into the well and the bayonet catch released by a slight turn. The split ring then grips the wall of the bore-hole and further downward movement of the flow pipe expands the rubber, as shown in Fig. 2, to seal the hole. If required, liquid can be pumped down the bore-hole and find its way into the flow pipe through the non-return valve L.—*May 3rd*, 1935.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY, JUNE 19TH.

MANCHESTER ASSOC. OF ENGINEERS.—Visit to works. Joseph Wedgwood and Sons, Ltd., Pottery Works, Etruria, Stoke-on-Trent. Leave Omnibus Station, Lower Mosley-street, Manchester, 12.45 p.m.

SATURDAY, JUNE 22ND.

INST. OF AUTOMOBILE ENGINEERS: GRADUATES' SECTION.—Summer Rally at Burford, Oxon. The President, Mr. L. H. Pomeroy, and Mrs. Pomeroy will hold a reception at the Cotswold Gateway Hotel, Burford, at 3.30 p.m.

MONDAY, JUNE 24TH, TO WEDNESDAY, JUNE 26TH.

INST. OF HEATING AND VENTILATING ENGINEERS.—Summer meeting at Felixstowe. Headquarters, The Felix Hotel. Monday, Council meeting, 5.30 p.m. Tuesday, special meeting of members, 9.45 a.m. Paper, "Fan Characteristics," Mr. W. L. Gee. Reception at Felix Hotel, 6.45 p.m. Banquet and dancing, 7.15 p.m. Wednesday, circular motor drive. Luncheon by invitation of the President, Mr. W. E. Frotwell. Leave Felix Hotel, 10 a.m.

TUESDAY, JUNE 25TH, TO SATURDAY, JUNE 29TH.

BRITISH WATERWORKS ASSOC.—Summer Meeting at Cambridge. For provisional programme see page 382, April 12th.

SATURDAY, JUNE 29TH.

SOC. OF GLASS TECHNOLOGY: LONDON SECTION.—Visit to factory of Frank Cooper, Ltd., Oxford, and the Colleges.

WEDNESDAY, JULY 3RD.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Visit to the works of the Derwent Valley Water Board near Sheffield. Members will depart by motor coach, leaving the White Horse Hotel, Congreve-street, Birmingham, at 8.45 a.m.

THURSDAY, JULY 11TH.

INST. OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C.2. Conversazione to overseas members.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND CENTRE.—Annual Summer Meeting. Leave Birmingham, New-street, for Liverpool, 8.30 a.m.; visit Mersey Tunnel, Liverpool; luncheon at Hulme Hall, as guests of Messrs. Lever Brothers, 1 p.m.; tour of Port Sunlight works, 2 p.m.; leave for New Brighton, 4.30 p.m. Full particulars from the hon. secretary, Mr. H. Hooper, 54, New-street, Birmingham.

THURSDAY AND FRIDAY, JULY 11TH AND 12TH.

INST. OF MINING ENGINEERS.—Summer meeting at Newcastle-upon-Tyne. Thursday, general meeting at the House of the North of England Institute of Mining and Mechanical Engineers, Neville Hall. The following papers will be submitted for discussion:—"The Grading and Classification of Coal," Mr. H. Eustace Mitton; "Surface Coal Cleaning *versus* Clean Mining," Messrs. George Raw and F. F. Ridley; "Coal and the Marine Engineer," Engineer-Commander Townend; "Cleaning Plant at the Rising Sun Colliery, Wallsend," Mr. Kenelm C. Appleyard. 10 a.m. Luncheon at the Old Assembly Rooms, Westgate-road. 1.30 p.m. Visit the Rescue Station of the Durham and Northumberland Collieries Fire and Rescue Brigade, Elswick. 2.45 p.m. Or alternatively visit the cleaning plant at the Rising Sun Colliery of the Wallsend and Hebburn Coal Company, Ltd. 2.45 p.m. The Institution of Mining Engineers dinner at the Grand Assembly Rooms, Barras Bridge. 7.45 p.m. Friday, leave Neville Hall, 9.30 a.m., for The Chesters, arriving at 10.30 a.m. Luncheon at Otterburn Hall, 1 p.m. Reception and dance, by kind invitation of the Lord Mayor and Corporation of Newcastle-upon-Tyne, at the Grand Assembly Rooms, Barras Bridge. 9 p.m. to 1 a.m.

CONTRACTS AND ORDERS.

The Editor is always happy to print short announcements of contracts and orders in this column provided they are sent to him in time to have news value and that they are likely to interest readers.

THE ENGLISH ELECTRIC COMPANY, Ltd., is to supply to the Wallasey Corporation two single-deck, all-weather bus bodies with seating accommodation for twenty passengers, and to the Oldham Corporation four double-deck, top-covered bus bodies of composite construction, with seating accommodation for fifty-six passengers.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

G. AND A. HARVEY, Ltd., machine tool makers, Govan, Glasgow, have appointed Mr. F. L. Watson, M. Inst. C.E., M.I. Mech. E., Post Office House, Leeds, as their representative in Yorkshire, Lancashire, Cheshire, Nottinghamshire, Derbyshire, and Lincolnshire.

MR. FRED CLEMENTS has been appointed to a seat on the board of directors of the Park Gate Iron and Steel Co., Ltd., of Rotherham. He has been with the company for the last 30 years, and has been the general manager since 1923, an office he will continue to occupy.

ANGLO-HOLLANDIA MACHINERIES, Ltd., 1, Lloyd's-avenue, London, E.C.3, inform us that their principals, Messrs. Werkspoor, of Amsterdam, have reluctantly decided for economy reasons to discontinue as from July 1st their activities in the United Kingdom through the intermediary of our informants. All communications should be addressed to the Amsterdam head office after that date.